

# Operating Instructions

Diesel engine  
**12 V 1600 R50**

**MS15033/01E**



*Power. Passion. Partnership.*

| Engine model | kW/cyl.    | Application group                      |
|--------------|------------|--|
| 12V1600R50   | 58 kW/cyl. | 2A, Continuous operation, unrestricted |

Table 1: *Applicability*

Printed in Germany

© 2014 Copyright MTU Friedrichshafen GmbH

This Publication is protected by copyright and may not be used in any way whether in whole or in part without the prior written permission of MTU Friedrichshafen GmbH. This restriction also applies to copyright, distribution, translation, microfilming and storage or processing on electronic systems including data bases and online services.

This handbook is provided for use by maintenance and operating personnel in order to avoid malfunctions or damage during operation.

Subject to alterations and amendments.

# Table of Contents

|  |    |  |     |
|--|----|--|-----|
| 1 Safety   |    |  |     |
| 1.1 Important provisions for all products  | 5  | 7.1.2 Cylinder head cover - Removal and installation                               | 78  |
| 1.2 Personnel and organizational requirements  | 6  | 7.2 Fuel System  | 79  |
| 1.3 Transportation   | 7  | 7.2.1 Fuel system - Venting  | 79  |
| 1.4 Safety regulations for startup and operation   | 8  | 7.3 Fuel Filter  | 81  |
| 1.5 Safety regulations for maintenance and repair work                                       | 9  | 7.3.1 Fuel filter - Replacement  | 81  |
| 1.6 Fire prevention and environmental protection, fluids and lubricants, auxiliary materials | 12 | 7.3.2 Fuel prefilter - Drain condensate  | 83  |
| 1.7 Standards for safety notices in the text   | 14 | 7.3.3 Fuel prefilter - Filter element replacement                                  | 84  |
| 2 General Information  |    | 7.4 Air Filter   | 85  |
| 2.1 Engine side and cylinder designations  | 15 | 7.4.1 Air filter - Replacement   | 85  |
| 2.2 Engine layout  | 16 | 7.5 Air Intake   | 86  |
| 2.3 Sensors and actuators  | 17 | 7.5.1 Service indicator - Signal ring position check                               | 86  |
| 3 Technical Data   |    | 7.6 Lube Oil System, Lube Oil Circuit  | 87  |
| 3.1 Firing order   | 20 | 7.6.1 Engine oil level - Check   | 87  |
| 3.2 Engine - Main dimensions   | 21 | 7.6.2 Engine oil - Change  | 88  |
| 3.3 12V 1600 R50 engine data   | 22 | 7.7 Oil Filtration / Cooling   | 89  |
| 4 Operation  |    | 7.7.1 Engine oil filter - Replacement  | 89  |
| 4.1 Preparation for startup after a scheduled break in operation                             | 25 | 7.8 Coolant Circuit, General, High-Temperature Circuit                             | 90  |
| 4.2 Preparation for startup after extended out-of-service periods (>3 months)                | 26 | 7.8.1 Engine coolant - Level check   | 90  |
| 4.3 Starting the engine  | 27 | 7.8.2 Engine coolant - Change  | 91  |
| 4.4 Operational checks   | 28 | 7.8.3 Engine coolant - Draining  | 92  |
| 4.5 Engine - Stop  | 29 | 7.8.4 Engine coolant - Filling   | 94  |
| 4.6 After engine shutdown  | 30 | 7.8.5 Engine coolant pump - Relief bore check                                      | 96  |
| 4.7 Plant - Cleaning   | 31 | 7.9 Low-Temperature Circuit  | 97  |
| 4.8 Engine - Barring manually  | 32 | 7.9.1 Charge-air coolant level - Check   | 97  |
| 5 Maintenance  |    | 7.9.2 Charge-air coolant - Change  | 98  |
| 5.1 Maintenance task reference table [OL1]   | 33 | 7.9.3 Charge-air coolant - Draining  | 99  |
| 6 Troubleshooting  |    | 7.9.4 Charge-air coolant - Filling   | 100 |
| 6.1 Troubleshooting  | 34 | 7.9.5 Charge-air coolant pump - Relief bore check                                  | 102 |
| 6.2 Fault messages of engine governor ECU 9 for Series 1600, rail applications               | 37 | 7.10 Belt Drive  | 103 |
| 7 Task Description   |    | 7.10.1 Coolant pump - Drive belt replacement                                       | 103 |
| 7.1 Valve Drive  | 76 | 7.11 Battery-Charging Generator  | 105 |
| 7.1.1 Valve clearance - Check and adjustment   | 76 | 7.11.1 Battery-charging generator - Belt tensioner and diverter pulley replacement | 105 |
| 7.14 Accessories for (Electronic) Engine Governor / Control System                           |    | 7.11.2 Battery-charging generator - Drive belt removal and installation            | 107 |
| 7.14.1 Injector functions  |    | 7.12 Drive Systems, Driving End and Free End (Coupling)                            | 108 |
| 7.14.2 Engine governor and connectors - Cleaning   |    | 7.12.1 Coupling - Checking (radial/axial) play                                     | 108 |
| 7.14.3 Engine Control Unit - Plug connection check   |    | 7.13 Wiring (General) for Engine/Gearbox/Unit                                      | 109 |
| 7.13.1 Engine wiring - Check   |    | 7.13.1 Engine wiring - Check   | 109 |
| 7.14.1 Injector functions  |    | 7.14 Accessories for (Electronic) Engine Governor / Control System                 | 110 |
| 7.14.2 Engine governor and connectors - Cleaning   |    | 7.14.1 Injector functions  | 110 |
| 7.14.3 Engine Control Unit - Plug connection check   |    | 7.14.2 Engine governor and connectors - Cleaning                                   | 111 |
|  |    | 7.14.3 Engine Control Unit - Plug connection check                                 | 112 |

|                                    |     |  |     |
|------------------------------------|-----|--|-----|
| 7.14.4 NOx sensor - Replacement    | 113 | 8.2 MTU contact persons/service partners | 120 |
| 7.14.5 Lambda sensor - Replacement | 115 |  |     |
|                                    |     | 9 Appendix B                             |     |
| 8 Appendix A                       |     | 9.1 Special Tools                        | 121 |
| 8.1 Abbreviations                  | 117 | 9.2 Index                                | 125 |

# 1 Safety

## 1.1 Important provisions for all products

### Nameplate

The product is identified by nameplate, model designation or serial number and must match with the information on the title page of this manual.

Nameplate, model designation or serial number can be found on the product.

### General information

This product may pose a risk of injury or damage in the following cases:

- Incorrect use
- Operation, maintenance and repair by unqualified personnel
- Modifications or conversions
- Noncompliance with the safety instructions and warning notices

### Correct use

The product is intended exclusively for the application specified in the contract or defined at the time of delivery.

This means that the equipment must be operated:

- Within the permissible operating parameters in accordance with the (→ Technical data)
- With fluids and lubricants approved by the manufacturer in accordance with the (→ Fluids and Lubricants Specifications of the manufacturer)
- With spare parts approved by the manufacturer in accordance with the (→ Spare Parts Catalog/MTU contact/Service partner)
- In the original as-delivered configuration or in a configuration approved by the manufacturer in writing (including engine control/parameters)
- In compliance with all safety regulations and in adherence with all warning notices in this manual
- In accordance with the maintenance requirements over the entire service life of the product (→ Maintenance Schedule)
- In compliance with the maintenance and repair instructions contained in this manual, in particular with regard to the specified tightening torques
- With the exclusive use of technical personnel trained in commissioning, operation, maintenance and repair
- By contracting only workshops authorized by the manufacturer to carry out repair and overhaul

Any other use is considered improper use and increases the risk of personnel injury or material damage in product operation. The manufacturer will accept no liability for such damage.

### Modifications or conversions

Unauthorized modifications to the product compromise safety.

The manufacturer will accept no liability or warranty claims for any damage caused by unauthorized modifications or conversions.

### Spare parts

Only genuine spare parts must be used to replace components or assemblies.

The manufacturer will accept no liability or warranty claims for any damage caused by the use of other spare parts.

## 1.2 Personnel and organizational requirements

### **Organizational measures of the operator**

This manual must be issued to all personnel involved in operation, maintenance, repair or transportation.

Keep this manual handy in the vicinity of the product such that it is accessible to operating, maintenance, repair and transport personnel at all times.

Use this manual as a basis for instructing personnel on product operation and repair, whereby the safety-relevant instructions, in particular, must be read and understood.

This is particularly important in the case of personnel who only occasionally perform work on or around the product. This personnel must be instructed repeatedly.

### **Personnel requirements**

All work on the product shall be carried out by trained and qualified personnel only.

- Training at the Training Center of the manufacturer
- Qualified personnel specialized in mechanical and plant engineering

The operator must define the responsibilities of the personnel involved in operation, maintenance, repair and transport.

### **Working clothes and personal protective equipment**

Wear proper protective clothing for all work.

When working, always wear the necessary personal protective equipment (e.g. ear protectors, protective gloves, goggles, breathing protection). Observe the information on personal protective equipment in the respective activity description.

## 1.3 Transportation

### **Transportation**

Only use the lifting eyes provided to lift the engine.

Only use transport and lifting devices approved by MTU.

Take the engine's center of gravity into account.

Lift engines by approx. 10 mm and verify that the lifting ropes / chains between engine and lifting equipment run vertically or in accordance with the specifications on the installation drawing.

If this is not the case, the lifting equipment must be re-adjusted.

The engine must only be transported in installation position, max. permissible diagonal pull 10°.

If the engine is supplied with special aluminum foil packing, lift the engine at the lifting eyes of the bearing pedestal or use a means of transportation which is appropriate for the given weight (forklift truck).

### **Setting the engine down after transport**

Only set down engine on a firm, level surface.

Make sure that the consistency and load-bearing capacity of the ground or support surface is adequate.

Never set an engine down on the oil pan unless expressively authorized to do so by MTU on a case-to-case basis .

## 1.4 Safety regulations for startup and operation

### Safety regulations for startup

Install the product correctly and carry out acceptance in accordance the manufacturer's specifications before putting the product into service.

Before the product is put into operation for the first time, all official authorizations must be available and commissioning preconditions met.

When putting the product into operation, always ensure that

- All maintenance and repair work has been completed.
- All loose parts have been removed from rotating machine components.
- All personnel is clear of the danger zone surrounding moving parts of the machine.
- The service room is adequately ventilated.
- The exhaust system is leak-tight and that the gases are vented to atmosphere.
- Protect battery terminals, generator terminals or cables against accidental contact.

Immediately after putting the product into operation, make sure that all control and display instruments as well as the monitoring, signaling and alarm systems work properly.

### Safety regulations for equipment operation

The operator must be familiar with the controls and displays.

The operator must be familiar with the consequences of any operations performed.

During operation, the display instruments and monitoring units must be permanently observed with regard to present operating status, violation of limit values and warning or alarm messages.

### Malfunctions and emergency stop

The procedures for cases of emergency, in particular, emergency stop, must be practiced regularly.

The following steps must be taken if a malfunction of the system is recognized or reported by the system:

- Inform supervisor(s) in charge.
- Analyze the message.
- If required, carry out emergency operations e.g. emergency stop.

### Operation

Do not remain in the operating room when the product is running for any longer than absolutely necessary.

Keep a safe distance away from the product if at all possible. Do not touch the product unless expressly instructed to do so following a written procedure.

Do not inhale the exhaust gases of the product.

The following requirements must be fulfilled before the product is started:

- Wear ear protectors.
- Mop up any leaked or spilled fluids and lubricants immediately or soak up with a suitable binder agent.

### Operation of electrical equipment

When electrical equipment is in operation, certain components of these appliances are electrically live.

Observe the safety instructions for these devices.

## 1.5 Safety regulations for maintenance and repair work

### Safety regulations prior to maintenance and repair work

Have maintenance or repair work carried out by qualified and authorized personnel only.

Allow the product to cool down to less than 50°C before starting maintenance work (risk of explosion of oil vapors, fluids and lubricants, risk of burning).

Before starting work, relieve pressure in systems and compressed-air lines which are to be opened. Use suitable containers of adequate capacity to catch fluids and lubricants.

When changing the oil or working on the fuel system, ensure that the service room is adequately ventilated.

Never carry out maintenance and repair work with the product in operation, unless:

- Expressly permitted to do so following a written procedure.
- The product is running in the low load range and only for as long as absolutely necessary.

Secure the product against unintentional starting, e.g. with start interlock.

Attach "Do not operate" sign in the operating area or to control equipment.

Disconnect the battery. Lock contactors.

Close the main valve on the compressed-air system and vent the compressed-air line when pneumatic starters are fitted.

Disconnect the control equipment from the product.

The following applies to starters with copper-beryllium alloy pinions:

- Wear breathing protection of filter class P3 during maintenance work. Do not blow out the interior of the flywheel housing or the starter with compressed air. Clean the flywheel housing inside with a class H dust extraction device.
- Observe the safety data sheet.

### Safety regulations during maintenance and repair work

Take special care when removing ventilation or plug screws from the product. Cover the screw or plug with a rag to prevent fluids escaping under pressure.

Take care when draining hot fluids and lubricants (risk of burning).

Use only proper and calibrated tools. Observe the specified tightening torques during assembly or disassembly.

Carry out work only on assemblies or plants which are properly secured.

Never use lines for climbing.

Keep fuel injection lines and connections clean.

Always seal connections with caps or covers if a line is removed or opened.

Take care not to damage lines, in particular fuel lines, during maintenance and repair work.

Ensure that all retainers and dampers are installed correctly.

Ensure that all fuel injection and pressurized oil lines are installed with enough clearance to prevent contact with other components. Do not place fuel or oil lines near hot components.

Do not touch elastomeric seals if they have carbonized or resinous appearance unless hands are properly protected.

Note cooling time for components which are heated for installation or removal (risk of burning).

When working high on the equipment, always use suitable ladders and work platforms. Make sure components or assemblies are placed on stable surfaces.

Ensure particular cleanliness during maintenance and repair work on the product. After completion of maintenance and repair work, make sure that no unattached parts are in/on the product (e.g. cloths and cable ties).

## **Safety regulations after completion of maintenance and repair work**

Before barring, make sure that nobody is standing in the danger zone of the product.

Check that all guards have been reinstalled and that all tools and loose parts have been removed after working on the product (in particular, the barring tool).

## **Welding work**

Welding operations on the product or mounted units are not permitted. Cover the product when welding in its vicinity.

Before starting welding work:

- Switch off the power supply master switch.
- Disconnect the battery.
- Separate the electrical ground of electronic equipment from the ground of the unit.

No other maintenance or repair work must be carried out in the vicinity of the product while welding is going on. Risk of explosion or fire due to oil vapors and highly flammable fluids and lubricants.

Do not use product as ground terminal.

Never position the welding power supply cable adjacent to, or crossing wiring harnesses of the product. The welding current may otherwise induce an interference voltage in the wiring harnesses which could conceivably damage the electrical system.

Remove parts (e.g. exhaust pipes) which are to be welded from the product beforehand.

## **Hydraulic installation and removal**

Check satisfactory function and safe operating condition of tools, jigs and fixtures to be used. Use only the specified jigs and fixtures for hydraulic removal/installation procedures.

Observe the max. permissible force-on pressure specified for the jig/fixture.

Do not attempt to bend or apply force to lines.

Before starting work, pay attention to the following:

- Vent the hydraulic installation/removal jig, the pumps and the lines at the relevant points for the equipment to be used (e.g. open vent plugs, pump until bubble-free air emerges, close vent plugs).
- For hydraulic installation, screw on the jig with the piston retracted.
- For hydraulic removal, screw on the jig with the piston extended.

For a hydraulic installation/removal jig with central expansion pressure supply, screw spindle into shaft end until correct sealing is established.

During hydraulic installation and removal, ensure that nobody is standing in the immediate vicinity of the component to be installed/removed.

## **Working with batteries**

Observe the safety instructions of the battery manufacturer when working with batteries.

Gases emanating from the battery are explosive. Avoid sparks and naked flames.

Do not allow electrolyte to come in contact with skin or clothing.

Wear goggles and protective gloves.

Never place tools on the battery.

Before connecting the cable to the battery, check the battery polarity. Battery pole reversal may lead to injury through the sudden discharge of acid or bursting of the battery body.

## **Working on electrical and electronic assemblies**

Always obtain the permission of the person in charge before commencing maintenance and repair work or switching off any part of the electronic system required to do so.

De-energize the appropriate areas prior to working on assemblies.

Do not damage cabling during removal work. When reinstalling ensure that wiring is not damaged during operation by contact with sharp objects, by rubbing against other components or by a hot surface.

Do not secure cables on lines carrying fluids.

Do not use cable straps to secure cables.

Always use connector pliers to tighten union nuts on connectors.

Subject the device as well as the product to a function check on completion of all repair work. In particular, check the function of the engine emergency stop feature.

Store spare parts properly prior to replacement, i.e. protect them against moisture in particular. Pack defective electronic components and assemblies in a suitable manner when dispatched for repair, i.e. protected, in particular, against moisture and impact and wrapped in antistatic foil if necessary.

## **Working with laser equipment**

When working with laser equipment, always wear special laser-protection goggles (hazard due to heavily focused radiation).

Laser equipment must be equipped with the protective devices necessary for safe operation according to type and application.

For conducting light-beam procedures and measurement work, only the following laser devices must be used:

- Laser devices of classes 1, 2 or 3A.
- Laser devices of class 3B, which have maximum output in the visible wavelength range (400 to 700 nm), a maximum output of 5 mW, and in which the beam axis and surface are designed to prevent any risk to the eyes.

## 1.6 Fire prevention and environmental protection, fluids and lubricants, auxiliary materials

### **Fire prevention**

Rectify any fuel or oil leaks immediately. Oil or fuel on hot components can cause fires – therefore always keep the product in a clean condition. Do not leave rags saturated with fluids and lubricants on the product. Do not store combustible materials near the product.

Do not carry out welding work on pipes and components carrying oil or fuel. Before welding, clean with a nonflammable fluid.

When starting the engine with an external power source, connect the ground lead last and remove it first. To avoid sparks in the vicinity of the battery, connect the ground lead from the external power source to the ground lead of the engine or to the ground terminal of the starter.

Always keep suitable firefighting equipment (fire extinguishers) at hand and familiarize yourself with their use.

### **Noise**

Noise can lead to an increased risk of accidents if it makes it more difficult to hear audible signals, warning calls or noises indicating danger.

Wear ear protectors in workplaces with a sound pressure level in excess of 85dB (A).

### **Environmental protection and disposal**

Modification or removal of any mechanical/electronic components or the installation of additional components including the execution of calibration processes that might affect the emission characteristics of the product are prohibited by emission regulations. Emission control units/systems may only be maintained, exchanged or repaired if the components used for this purpose are approved by the manufacturer. Noncompliance with these guidelines will invalidate the design type approval issued by the emissions regulation authorities. The manufacturer does not accept any liability for violations of the emission regulations. The maintenance schedules of the manufacturer must be observed over the entire life cycle of the product.

Dispose of used fluids, lubricants and filters in accordance with local regulations.

Within the EU, batteries can be returned free of charge to the manufacturer where they will be properly recycled.

### **Consumable fluids and materials**

The Fluids and Lubricants Specifications will be amended or supplemented as necessary. Prior to operation, make sure that the latest version is used. The latest version can be found on the website on the "Technical Info" or "Spare Parts and Service" tabs at <http://www.mtu-online.com>.

Consumable fluids and materials may also be hazardous or toxic. When using fluids, lubricants, consumables and other chemical substances, follow the safety regulations that apply to the product. Take special care when using hot, chilled or caustic substances. When using flammable materials, prevent them coming into contact with ignition sources and do not smoke.

### **Used oil**

Used oil contains combustion residues that are harmful to health.

Rub barrier cream into hands.

Wash hands after contact with used oil.

## Lead

- Adopt suitable measures to avoid the formation of lead dust.
- Switch on extraction system.
- When working with lead or pastes that contain lead, avoid direct contact with the skin. Do not inhale lead vapors.
- Wash hands after contact with lead or lead-containing substances.

## Compressed air

Observe special safety precautions when working with compressed air:

- Unauthorized use of compressed air, e.g. forcing flammable liquids (hazard class Al, AII and B) out of containers, risks causing an explosion.
- Wear goggles when blowing dirt off workpieces or blowing away swarf.
- Blowing compressed air into thin-walled containers (e.g. containers made of sheet metal, plastic or glass) for drying purposes or to check for leaks risks bursting them.
- Pay special attention to the pressure in the compressed air system or pressure vessel.
- Assemblies or products to be connected must either be designed for that pressure, or, if the permissible pressure is lower than the system pressure, a pressure reducing valve and safety valve (set to the permissible pressure) must be connected between the assemblies/products and the system.
- Hose couplings and connections must be securely attached.
- Provide the snout of the air nozzle with a protective disk (e.g. rubber disk).
- First shut off compressed air lines before compressed air device is disconnected from the supply line, or before device or tool is to be replaced.
- Carry out leak test in accordance with the specifications.

## Paints and varnishes

- Observe the relevant safety data sheet for all materials.
- When painting in areas other than spray booths equipped with extractors, ensure good ventilation. Make sure that neighboring work areas are not adversely affected.
- There must be no naked flames in the vicinity.
- No smoking.
- Observe fire prevention regulations.
- Always wear a mask providing protection against paint and solvent vapors.

## Liquid nitrogen

- Observe the relevant safety data sheet for all materials.
- Store liquid nitrogen only in small quantities and always in regulation containers (without gas-tight caps).
- Avoid body contact (eyes, hands).
- Wear protective clothing, protective gloves, closed shoes and safety goggles.
- Make sure that working area is well ventilated.
- Avoid knocking or jolting the containers, valves and fittings or workpieces in any way.

## Acids/alkaline solutions/urea (AdBlue®, DEF)

- Observe the relevant safety data sheet for all materials.
- When working with acids and alkaline solutions, wear goggles or face mask, gloves and protective clothing.
- Do not inhale vapors.
- If urea solution is swallowed, rinse out mouth and drink plenty of water.
- If spilled onto clothing, remove the affected clothing immediately.
- After contact with skin, rinse affected parts of the body with plenty of water.
- Rinse eyes immediately with eyedrops or clean tap water. Seek medical attention as soon as possible.

## 1.7 Standards for safety notices in the text

|                |  |
|----------------|--|
| <b>DANGER</b>  | <br>In the event of immediate danger.<br><b>Consequences: Death, serious or permanent injury!</b> <ul style="list-style-type: none"><li>• Remedial action.</li></ul>  |
| <b>WARNING</b> | <br>In the event of a situation involving potential danger.<br><b>Consequences: Death, serious or permanent injury!</b> <ul style="list-style-type: none"><li>• Remedial action.</li></ul>  |
| <b>CAUTION</b> | <br>In the event of a situation involving potential danger.<br><b>Consequences: Minor or moderate injuries!</b> <ul style="list-style-type: none"><li>• Remedial action.</li></ul>  |
| <b>NOTICE</b>  | <br>In the event of a situation involving potentially adverse effects on the product.<br><b>Consequences: Material damage!</b> <ul style="list-style-type: none"><li>• Remedial action.</li><li>• Additional product information.</li></ul> |

### Safety notices

- This manual with all safety instructions and safety notices must be issued to all personnel involved in operation, maintenance, repair or transportation.

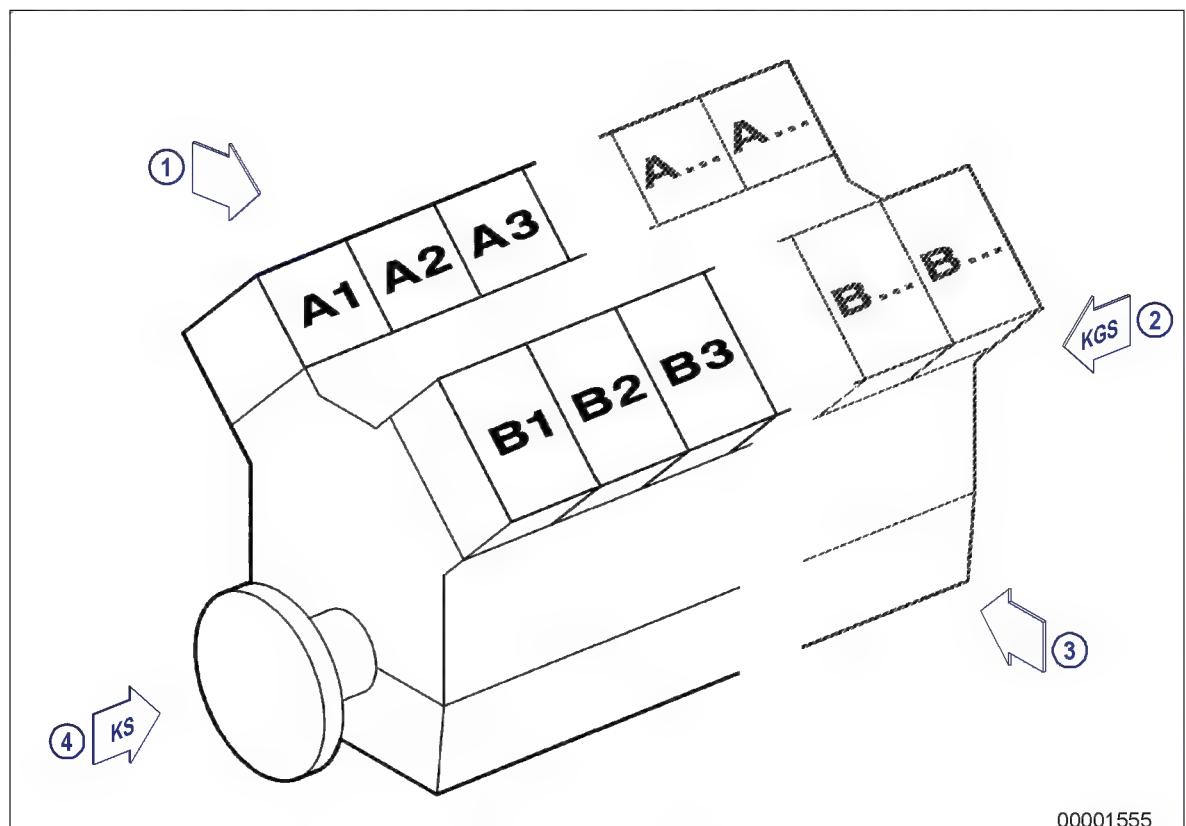
## 2 General Information

### 2.1 Engine side and cylinder designations

Engine sides are always designated as viewed from the driving end (KS) (4).

For designation of the cylinders (to DIN ISO 1204) the letter "A" (1) is used to refer to the cylinders on the left-hand side of the engine and the letter "B" (3) to refer to the cylinders on the right-hand side. The cylinders of each bank are numbered consecutively, starting with No. 1 at the driving end.

The numbering of other engine components also starts with no. 1 at the driving end.



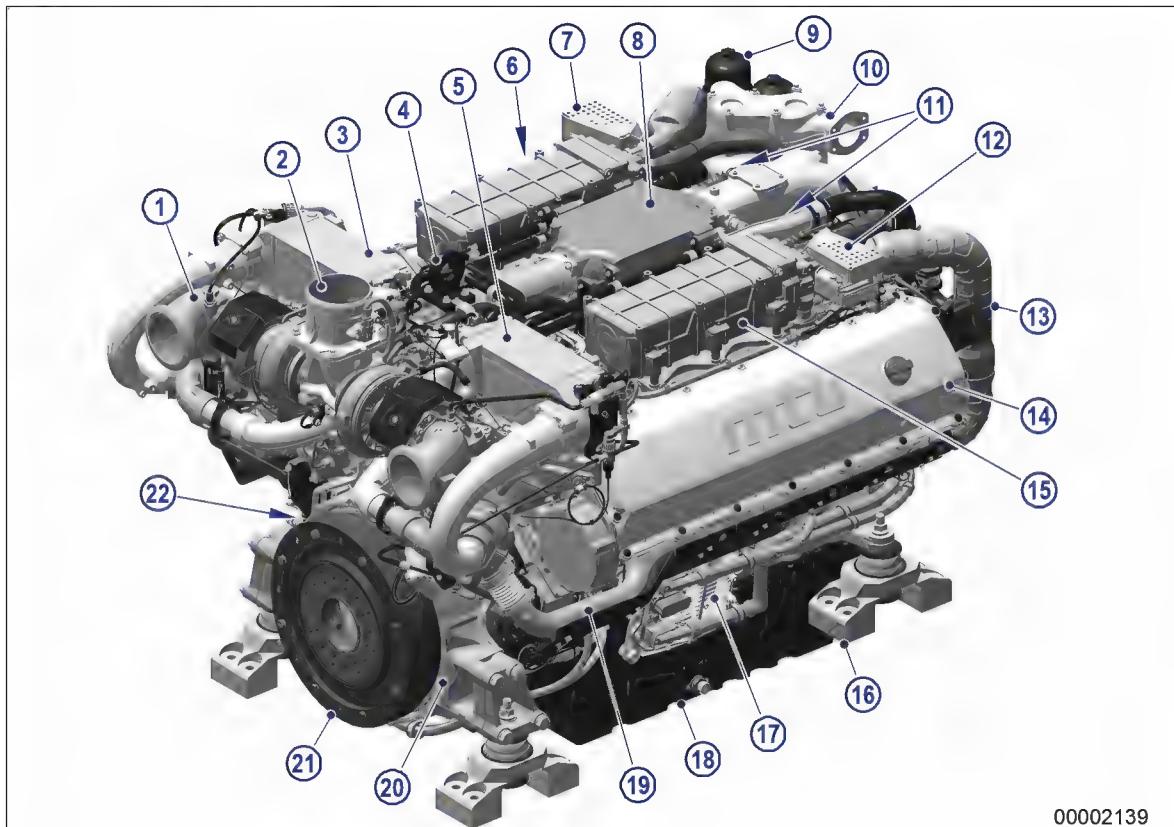
1 Left-hand side of engine

2 Free end

3 Right-hand side of engine

4 Driving end

## 2.2 Engine layout



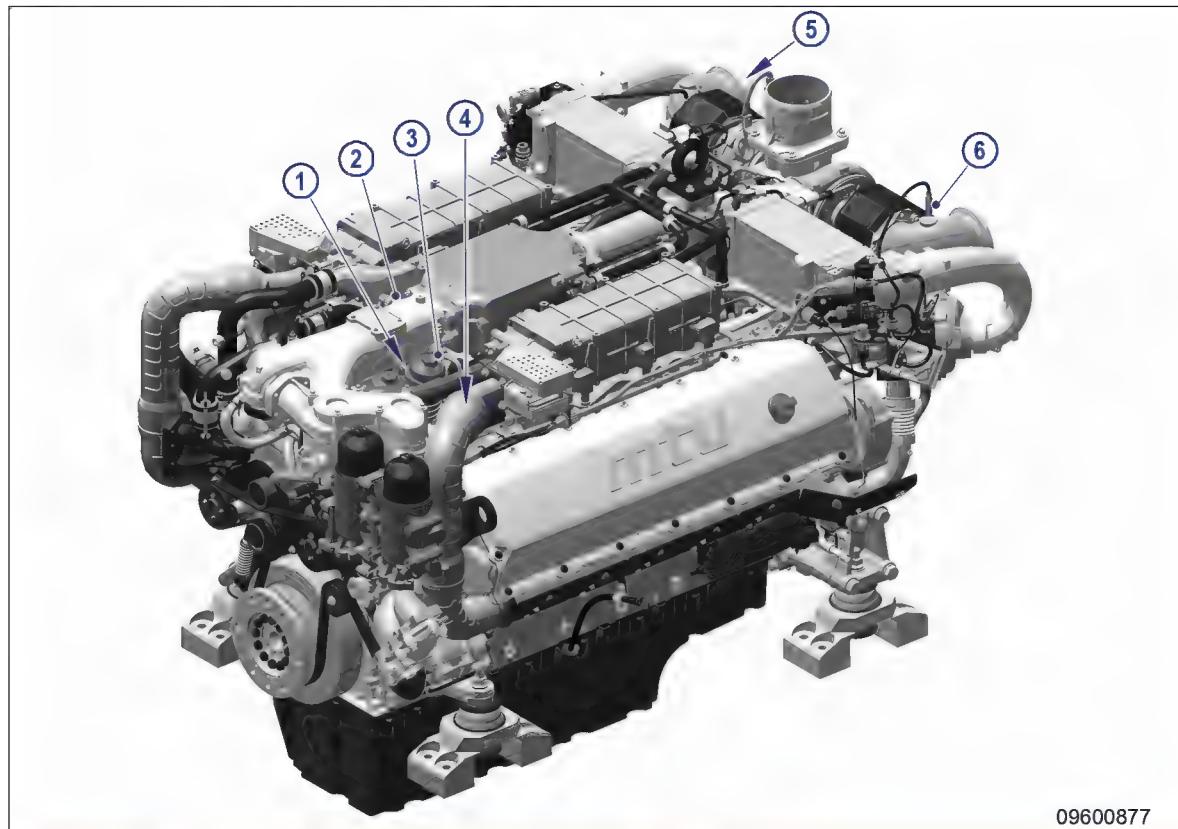
|                              |                               |                     |
|------------------------------|-------------------------------|---------------------|
| 1 Exhaust outlet             | 9 Fuel filter                 | 17 Engine governor  |
| 2 Air intake                 | 10 Thermostat housing         | 18 Oil pan          |
| 3 Intermediate intercooler   | 11 Oil filter                 | 19 Exhaust elbow    |
| 4 Lifting eye, driving end   | 12 EGR flap before EGR cooler | 20 Flywheel housing |
| 5 Intermediate intercooler   | 13 Lifting eye, free end      | 21 Coupling         |
| 6 Oil dipstick               | 14 Cylinder head              | 22 Starter          |
| 7 EGR flap before EGR cooler | 15 EGR cooler                 |                     |
| 8 Intercooler                | 16 Engine mount               |                     |

### Engine model designation

Key to the engine model designations 12 V 1600 Rxy

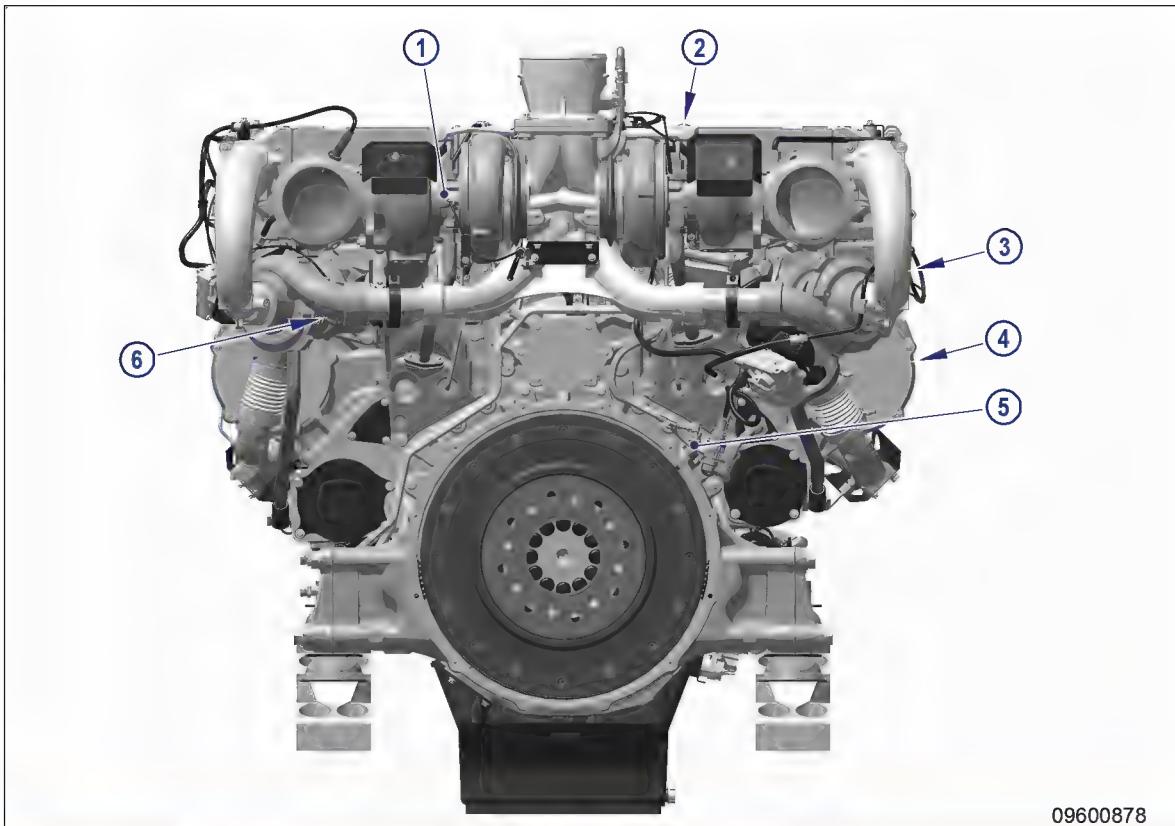
|      |                                |
|------|--------------------------------|
| 12   | Number of cylinders            |
| V    | Cylinder arrangement: V engine |
| 1600 | Series                         |
| R    | Application                    |
| x    | Application segment            |
| y    | Design index                   |

## 2.3 Sensors and actuators

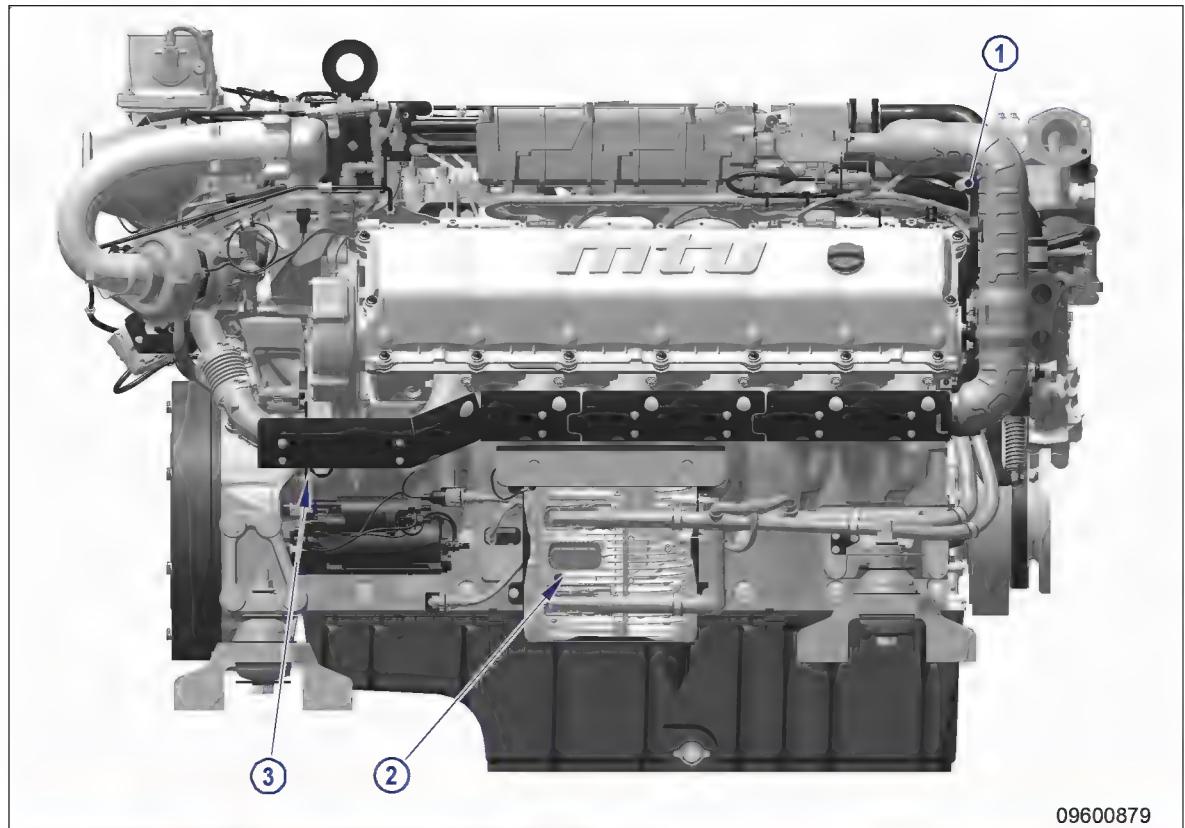


09600877

| No | Description | Monitoring of  |
|----|-------------|--|
| 1  | B5.1        | Lube oil pressure after filter                         |
| 2  | B10         | Charge-air pressure                                    |
| 3  | B9.1        | Charge-air temperature before EGR                      |
| 4  | B5.3        | Lube oil pressure before filter                        |
| 5  | B89         | Residual oxygen content in exhaust gas (Lambda sensor) |
| 6  | B88         | Nitrogen oxide levels in exhaust gas (NOx sensor)      |



| No. | Description | Monitoring of        |
|-----|-------------|----------------------|
| 1   | B44.3       | Turbocharger C speed |
| 2   | B44.4       | Turbocharger D speed |
| 3   | B44.2       | Turbocharger B speed |
| 4   | B1          | Camshaft speed       |
| 5   | B13         | Crankshaft speed     |
| 6   | B44.1       | Turbocharger A speed |



09600879

| Nu. | Description | Monitoring of                  |
|-----|-------------|--------------------------------|
| 1   | B26         | Charge-air coolant temperature |
| 2   | B93         | Lube oil level                 |
| 3   | B4.22       | Exhaust temperature, B-side    |

## 3 Technical Data

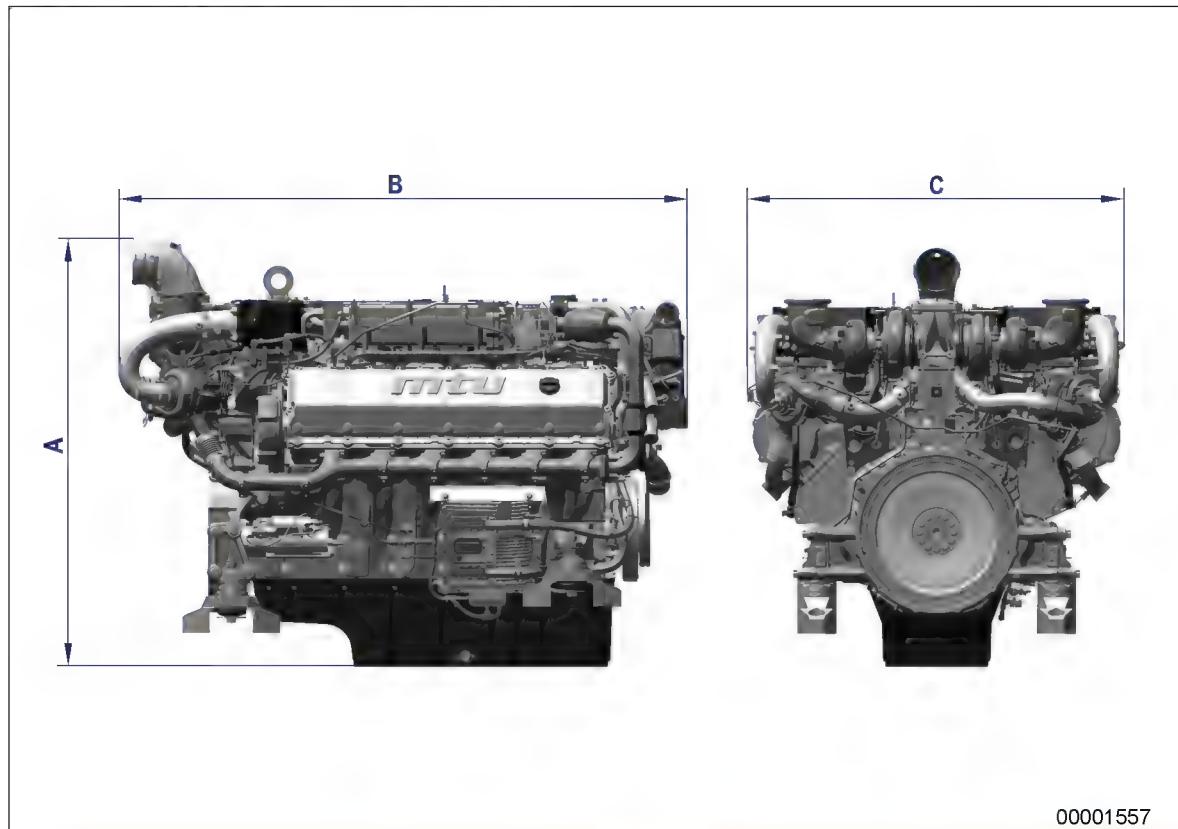
### 3.1 Firing order

|      |                                     |
|------|-------------------------------------|
| 12 V | A1-B2-A5-B4-A3-B1-A6-B5-A2-B3-A4-B6 |
|------|-------------------------------------|

#### Direction of rotation

|  |                        |
|--|------------------------|
| Direction of rotation (as viewed on driving end) | c.c.w., not reversible |
|--|------------------------|

### 3.2 Engine - Main dimensions



00001557

| Item       | Dimensions      |
|------------|-----------------|
| Length (A) | approx. 1871 mm |
| Width (B)  | approx. 1228 mm |
| Height (C) | approx. 1327 mm |

### 3.3 12V 1600 R50 engine data

Explanation:

- DL Ref. value: Continuous power
- BL Ref. value: Fuel stop power
- A Design value
- G Guaranteed value
- R Guideline value
- L Limit value, up to which the engine can be operated, without change (e.g. of power setting)
- N Not yet defined value
- Not applicable
- X Applicable
- \* Provisional value

#### Reference conditions

| Engine model                   | 12V 1600 R50 |  |     |
|--------------------------------|--------------|--|-----|
| Application group              |              |  | 2A  |
| Intake air temperature         | °C           |  | 25  |
| Charge-air coolant temperature | °C           |  | 45  |
| Barometric pressure            | mbar         |  | 981 |
| Site altitude above sea level  | m            |  | 400 |

#### Power-related data (power ratings are net brake power as per ISO 3046)

| Number of cylinders      | 12    |  |      |
|--------------------------|-------|--|------|
| Rated engine speed       | A rpm |  | 1900 |
| Fuel stop power ISO 3046 | A kW  |  | 690  |

#### General conditions (for maximum power)

| Number of cylinders  | 12     |  |    |
|--|--------|--|----|
| Intake depression (new filter)   | A mbar |  | 25 |
| Intake depression, max.  | L mbar |  | 35 |
| Fuel temperature at engine inlet connection, max (w/o power reduction) | L °C   |  | 70 |

#### Consumption

| Number of cylinders  | 12      |  |     |
|--|---------|--|-----|
| Specific fuel consumption (be) - Best point (+5%; EN 590; 42.8MJ/kg) | R g/kWh |  | 194 |

#### Model-related data (basic design)

| Number of cylinders           | 12          |  |      |
|-------------------------------|-------------|--|------|
| Number of cylinders           |             |  | 12   |
| Cylinder arrangement: V angle | Degrees (°) |  | 90   |
| Bore                          | mm          |  | 122  |
| Stroke                        | mm          |  | 150  |
| Cylinder displacement         | liters      |  | 1.75 |
| Total displacement            | liters      |  | 21   |

| Number of cylinders                   |  |  | 12   |
|---------------------------------------|--|--|------|
| Compression ratio                     |  |  | 17.7 |
| Number of inlet valves per cylinder   |  |  | 2    |
| Number of exhaust valves per cylinder |  |  | 2    |

### Combustion air / exhaust gas

| Number of cylinders                    |   |    | 12  |
|--|---|----|-----|
| Exhaust temperature after turbocharger | R | °C | 350 |

### Coolant system (high-temperature circuit)

| Number of cylinders   |   |     | 12  |
|---|---|-----|-----|
| Coolant temperature (at engine connection: outlet to cooling equipment) | A | °C  | 95  |
| Coolant temperature after engine, shutdown                              | L | °C  | 112 |
| Coolant pump: inlet pressure, max.                                      | L | bar | 2.5 |
| Thermostat: Starts to open  | R | °C  | 75  |
| Thermostat: Fully open  | R | °C  | 92  |

### Coolant system (low-temperature circuit)

| Number of cylinders                |   |     | 12  |
|------------------------------------|---|-----|-----|
| Coolant pump: inlet pressure, max. | L | bar | 2.5 |
| Thermostat: Starts to open         | R | °C  | 30  |
| Thermostat: Fully open             | R | °C  | 45  |

### Lube oil system

| Number of cylinders                          |   |     | 12  |
|--|---|-----|-----|
| Lube oil temperature before engine, shutdown | L | °C  | 130 |
| Lube oil pressure before engine, shutdown    | L | bar | 3.3 |

### Fuel system

| Number of cylinders  |   |     | 12    |
|--|---|-----|-------|
| Fuel pressure at engine inlet connection, min. (when engine is starting) | L | bar | -0.65 |

### Capacities

| Number of cylinders  |   |        | 12 |
|--|---|--------|----|
| Engine coolant, engine side (without cooling equipment)  | R | liters | 60 |
| Charge-air coolant, engine side  | R | liters | 15 |
| Engine oil, initial filling (standard oil system) (Option: max. operating inclinations)              | R | liters | 75 |
| Oil change quantity, max. (standard oil system) (Option: max. operating inclinations)                | R | liters | 71 |
| Oil pan capacity at dipstick mark "min." (standard oil system) (Option: max. operating inclinations) | L | liters | 58 |
| Oil pan capacity at dipstick mark "max." (standard oil system) (Option: max. operating inclinations) | L | liters | 65 |

## Weights / main dimensions

| Number of cylinders                            | R | kg | 12   |
|--|---|----|------|
| Dry engine weight (basic-configuration engine) | R | kg | 2309 |

## Acoustics

| Number of cylinders   | R | dB(A) | 12  |
|---|---|-------|-----|
| Exhaust noise, unsilenced - BL (free-field sound-pressure level Lp, 1m distance, ISO 6798, +3dB(A) tolerance)                                   | R | dB(A) | 102 |
| Engine surface noise with attenuated intake noise (filter) - BL (free-field sound-pressure level Lp, 1 m distance, ISO 6798, +2dB(A) tolerance) | R | dB(A) | 110 |

# 4 Operation

## 4.1 Preparation for startup after a scheduled break in operation

### Preconditions

Engine is stopped and starting disabled.

### Starting up

| Item                  | Action   |
|-----------------------|--|
| Lube oil system       | Check engine oil level (→ Page 87).  |
| Coolant circuit       | Check engine coolant level (→ Page 90);<br>Check charge-air coolant level (→ Page 97). |
| Coolant circuit       | Preheat engine coolant with coolant preheating unit (if fitted).                       |
| Fuel prefilter        | Drain fuel prefilter (→ Page 83).  |
| Engine control system | Switch on.   |

## 4.2 Preparation for startup after extended out-of-service periods (>3 months)

### Preconditions

- Engine is stopped and starting disabled.
- MTU Fluids and Lubricants Specifications (A001063/..) are available.

### Startup after long out-of-service periods (>3 months)

| Item                  | Action   |
|-----------------------|--|
| Engine                | Depreserve (→ MTU Fluids and Lubricants Specifications A001063/..).  |
| Lube oil system       | Check engine oil level (→ Page 87).  |
| Fuel system           | Vent (→ Page 79).  |
| Coolant circuit       | If engine is out of service for more than one year, change engine coolant (→ Page 91).<br>Change charge-air coolant (→ Page 98). |
| Coolant circuit       | Check engine coolant level (→ Page 90);<br>Check charge-air coolant level (→ Page 97).   |
| Coolant circuit       | Preheat engine coolant with coolant preheating unit (if fitted).   |
| Engine governor       | Check plug-in connections (→ Page 112).  |
| Engine control system | Switch on.   |

## 4.3 Starting the engine

### Preconditions

- Engine is not connected to load.
- External start interlock is not active.

#### DANGER



Rotating and moving engine parts.

#### Risk of crushing, danger of parts of the body being caught or pulled in!

- Before cranking the engine with starter system, make sure that there are no persons in the engine's danger zone.

#### WARNING



High level of engine noise when the engine is running.

#### Risk of damage to hearing!

- Wear ear protectors.

### Starting engine

| Item  | Action   |
|---|--|
| Switchgear cabinet, operator station etc. (depending on manufacturer) | <p>Press start button.</p> <ul style="list-style-type: none"><li>• Automatic starting sequence is executed.</li><li>• Tachometer indicates increasing speed.</li><li>• After the starting procedure is completed, engine is running at idle speed.</li></ul> |

## 4.4 Operational checks

|                |  |
|----------------|--|
| <b>DANGER</b>  | <br>Rotating and moving engine parts.<br><b>Risk of crushing, danger of parts of the body being caught or pulled in!</b> <ul style="list-style-type: none"><li>Only run the engine at low power. Keep away from the engine's danger zone.</li></ul> |
| <b>WARNING</b> | <br>High level of engine noise when the engine is running.<br><b>Risk of damage to hearing!</b> <ul style="list-style-type: none"><li>Wear ear protectors.</li></ul>  |

### Operational checks

| Item                       | Action  |
|----------------------------|---|
| Control and display panels | Check readings of operational data (speed, temperature, pressures).   |
| Engine oil                 | Check engine oil level (→ Page 87).   |
| Engine operation           | Check engine visually for leaks and general condition;<br>Check engine for abnormal running noises, exhaust color and vibrations (→ Page 34). |
| Air filter                 | Check filter restriction indicator on the air filter (if fitted) (→ Page 86).   |
| Exhaust gas system         | Check exhaust color (→ Page 34).  |
| Engine coolant pump        | Check relief bore (→ Page 96).  |
| Charge-air coolant pump    | Check relief bore (→ Page 102).   |

## 4.5 Engine - Stop

### Preconditions

- Engine is not connected to load

| NOTICE  |   |
|---|---|
|  | <p>Stopping the engine when it is running at full load subjects it to extreme thermal and mechanical stresses.</p> <p><b>Overheating of and, therefore, damage to components is possible!</b></p> <ul style="list-style-type: none"><li>• Before shutting down the engine, allow it to idle until the engine temperatures decrease and constant levels are indicated.</li></ul> |

### Stopping engine

| Item  | Action   |
|---|--|
| Temperature indications   | Wait until engine temperatures are constant.   |
| Switchgear cabinet, operator station etc. (depending on manufacturer) | <p>Press stop button.</p> <ul style="list-style-type: none"><li>• Automatic stopping procedure is performed.</li><li>• Engine at a standstill.</li></ul> |

## 4.6 After engine shutdown

### Preconditions

MTU Fluids and Lubricants Specifications (A001063/..) are available.

Note: If freezing temperatures are to be expected: Coolant pressure sensors installed in vertical position may be damaged if the coolant does not contain antifreeze additive.

### After engine shutdown

| Item                           | Action   |
|--------------------------------|--|
| Coolant circuit                | Drain engine coolant (→ Page 92);<br>Drain charge-air coolant (→ Page 99) if: <ul style="list-style-type: none"><li>• freezing temperatures are expected and the engine is to remain out of service for an extended period, but engine coolant has no antifreeze additive;</li><li>• the engine room is not heated;</li><li>• the coolant is not kept at a suitable temperature;</li><li>• the antifreeze concentration is insufficient for the engine-room temperature;</li><li>• antifreeze concentration is 50 % and engine-room temperature is below -40 °C.</li></ul> |
| Engine control system          | Switch off.  |
| Air intake and exhaust systems | If the engine is to remain out of service for more than 1 week, seal the engine's air and exhaust sides. If the engine is to remain out of service for more than 1 month, carry out preservation (→ MTU Fluids and Lubricants Specifications A001063/..).  |

## 4.7 Plant - Cleaning

### Preconditions

- Engine is stopped and starting disabled.
- Operating voltage is not applied.

### Special tools, Material, Spare parts

| Designation / Use     | Part No. | Qty. |
|-----------------------|----------|------|
| Steam jet cleaner     | -        | 1    |
| Cleaner (Hakupur 312) | 30390    | 1    |

|  |  |
|--|--|
| <b>WARNING</b><br>  | <p>Compressed air gun ejects a jet of pressurized air.<br/><b>Risk of injury to eyes and damage to hearing, risk of rupturing internal organs!</b></p> <ul style="list-style-type: none"><li>Never direct air jet at people.</li><li>Always wear safety goggles/face mask and ear defenders.</li></ul> |
| <b>WARNING</b><br> | <p>Steam jet cleaner ejects jet of pressurized water.<br/><b>Risk of injury to eyes and scalding!</b></p> <ul style="list-style-type: none"><li>Never direct water jet at people.</li><li>Wear protective clothing, protective gloves and safety goggles/face mask.</li></ul>                          |
| <b>NOTICE</b><br> | <p>Cleaning agents should not be left to take effect for too long.<br/><b>Damage to components is possible!</b></p> <ul style="list-style-type: none"><li>Observe manufacturer's instructions.</li></ul>   |
| <b>NOTICE</b><br> | <p>Blowing down product with compressed air.<br/><b>Entry of dirt and damage to components is possible!</b></p> <ul style="list-style-type: none"><li>Do not aim compressed air gun directly at seals or electronic components such as connectors or ECUs.</li></ul>                                   |

### Plant - Cleaning

- Carry out plant cleaning only in areas where an appropriate oil separator is provided (environmental protection).
- Prior to putting the cleaning unit into operation, read the Operating Instructions of the water/steam jet unit carefully and observe the safety precautions.
- For external cleaning of the plant with water or steam-jet cleaners:
  - The pressure of the high-pressure jet (cleaning jet) must not exceed 50 bar.
  - A minimum distance between spray nozzle and plant of 1 m must be observed.
  - The temperature of the cleaning medium must not exceed 80°C.
- For external cleaning with high-pressure jet, use a flat-mouth nozzle only.

Note: Never aim compressed air directly at electronic components.

- Carry out external cleaning as follows:
  - Seal all openings in a suitable way.
  - Remove coarse dirt.
  - Spray on cleaner sparingly and leave it for 1 to 5 minutes.
  - Use the high-pressure jet to remove the loosened dirt.
  - Dry engine with compressed air.

## 4.8 Engine - Barring manually

### Preconditions

Engine is stopped and starting disabled.

### Special tools, Material, Spare parts

| Designation / Use | Part No.  | Qty. |
|-------------------|-----------|------|
| Barring gear      | F6790714  | 1    |
| Adapter           | F30011619 | 1    |
| Ratchet adapter   | F30027340 | 1    |

#### DANGER



Rotating and moving engine parts.

#### Risk of crushing, danger of parts of the body being caught or pulled in!

- Before cranking the engine with starter system, make sure that there are no persons in the engine's danger zone.

### Barring engine manually

1. Remove guard plate from flywheel housing.
2. Engage barring gear in ring gear and install on flywheel housing.
3. Fit adapter and ratchet adapter on barring gear.
4. Rotate crankshaft in engine direction of rotation. Apart from the normal compression resistance, there should be no resistance.
5. For barring gear removal, follow reverse sequence of working steps.

# 5 Maintenance

## 5.1 Maintenance task reference table [QL1]

The maintenance tasks and intervals for this product are defined in the Maintenance Schedule. The Maintenance Schedule is a stand-alone publication.

The task numbers in this table provide reference to the maintenance tasks specified in the Maintenance Schedule.

| Task  | Maintenance tasks   |              |
|-------|---|--------------|
| W0500 | Check engine oil level.   | (→ Page 87)  |
| W0503 | Check maintenance indicator of air filter.  | (→ Page 28)  |
| W0506 | Check engine for abnormal running noises, exhaust color and vibrations.                                     | (→ Page 28)  |
| W0507 | Drain water and contaminants from fuel prefilter.   | (→ Page 28)  |
| W1001 | Replace fuel filter or fuel filter element.   | (→ Page 81)  |
| W1008 | Replace engine oil filter when changing engine oil, or when the interval (years) is reached, at the latest. | (→ Page 89)  |
| W1013 | Replace drive belt.   | (→ Page 103) |
| W1019 | Check radial play.  | (→ Page 108) |
| W1207 | Check valve clearance, adjust as necessary. ATTENTION! First adjustment after 1,000 operating hours.        | (→ Page 76)  |
| W1326 | Replace battery-charging generator belt tensioner and diverter pulley.                                      | (→ Page 105) |
| W1525 | Replace sensor.   | (→ Page 113) |
| W1526 | Replace sensor.   | (→ Page 115) |
| W1636 | Reset drift correction parameters (CDC) and enter injector coding (IIG).                                    | (→ Page 110) |
| W1675 | Replace fuel prefilter or fuel prefilter element.   | (→ Page 84)  |

# 6 Troubleshooting

## 6.1 Troubleshooting

### Engine does not turn when starter is actuated

| Component           | Cause   | Action  |
|---------------------|---|---|
| Battery             | Low or faulty   | Charge or replace (see manufacturer's documentation).                               |
|                     | Cable connections faulty                                | Check if cable connections are properly secured (see manufacturer's documentation). |
| Starter             | Engine cabling or starter faulty                        | Check cable connections for secure seating; Contact Service.                        |
| Engine wiring       | Faulty  | Check (→ Page 109).   |
| Engine Control Unit | Plug-in connections possibly loose                      | Check plug-in connections (→ Page 112).   |
| Engine              | Running gear blocked (engine cannot be barred manually) | Contact Service.  |

Table 2: Engine does not turn when starter is actuated

### Engine turns but does not fire

| Component           | Cause  | Action  |
|---------------------|--|---|
| Starter             | Poor rotation by starter: Battery low or faulty              | Charge or replace battery (see manufacturer's documentation). |
| Engine wiring       | Faulty   | Check (→ Page 112).   |
| Fuel system         | Air in fuel system, if fault occurs after filling the system | Vent fuel system (→ Page 79).                                 |
| Engine Control Unit | Faulty   | Contact Service.  |

Table 3: Engine turns but does not fire

### Engine fires unevenly

| Component                | Cause  | Action                        |
|--------------------------|--|-------------------------------|
| Fuel injection equipment | Injector faulty  | Contact Service.              |
| Engine wiring            | Faulty   | Check (→ Page 109).           |
| Fuel system              | Air in fuel system, if fault occurs after filling the system | Vent fuel system (→ Page 79). |
| Engine Control Unit      | Faulty   | Contact Service.              |

Table 4: Engine fires unevenly

### Engine does not reach rated speed

| Component   | Cause                              | Action   |
|-------------|------------------------------------|--|
| Fuel supply | Fuel prefilter (if fitted) clogged | Clean filter element (see manufacturer's documentation). |
|             | Fuel filter clogged                | Replace (→ Page 81).                                     |

| Component                | Cause              | Action                          |
|--------------------------|--------------------|---------------------------------|
| Air supply               | Air filter clogged | Replace air filter (→ Page 85). |
| Fuel injection equipment | Injector faulty    | Contact Service.                |
| Engine wiring            | Faulty             | Check (→ Page 109).             |
| Engine                   | Overloaded         | Contact Service.                |

Table 5: Engine does not reach rated speed

### Engine speed not steady

| Component                | Cause  | Action                        |
|--------------------------|--|-------------------------------|
| Fuel injection equipment | Injector faulty  | Contact Service.              |
| Speed sensor             | Faulty   | Contact Service.              |
| Fuel system              | Air in fuel system, if fault occurs after filling the system | Vent fuel system (→ Page 79). |
| Engine Control Unit      | Faulty   | Contact Service.              |

Table 6: Engine speed not steady

### Charge-air temperature too high

| Component      | Cause                              | Action                                      |
|----------------|------------------------------------|---|
| Engine coolant | Engine coolant treatment incorrect | Check (MTU test kit).                       |
| Intercooler    | Contaminated                       | Contact Service.                            |
| Engine room    | Air-intake temperature too high    | Check fan;<br>check air inlet/outlet ducts. |

Table 7: Charge-air temperature too high

### Charge-air pressure too low

| Component            | Cause              | Action                          |
|----------------------|--------------------|---------------------------------|
| Air supply           | Air filter clogged | Replace air filter (→ Page 85). |
| Intercooler          | Contaminated       | Contact Service.                |
| Exhaust turbocharger | Faulty             | Contact Service.                |

Table 8: Charge-air pressure too low

### Coolant leaks at intercooler

| Component   | Cause                            | Action           |
|-------------|----------------------------------|------------------|
| Intercooler | Leaking, major coolant discharge | Contact Service. |

Table 9: Coolant leaks at intercooler

## Black exhaust gas

| Component                | Cause              | Action                          |
|--------------------------|--------------------|---------------------------------|
| Air supply               | Air filter clogged | Replace air filter (→ Page 85). |
| Fuel injection equipment | Injector faulty    | Contact Service.                |
| Engine                   | Overloaded         | Contact Service.                |

Table 10: Black exhaust gas

## Blue exhaust gas

| Component            | Cause                  | Action                        |
|----------------------|------------------------|-------------------------------|
| Engine oil           | Too much oil in engine | Drain engine oil (→ Page 88). |
| Exhaust turbocharger | Faulty                 | Contact Service.              |
| Cylinder head        |                        |                               |
| Piston rings         |                        |                               |
| Cylinder liner       |                        |                               |

Table 11: Blue exhaust gas

## White exhaust gas

| Component   | Cause                        | Action   |
|-------------|------------------------------|--|
| Engine      | Not at operating temperature | Run engine to reach operating temperature.                               |
| Fuel system | Water in fuel                | Check fuel system at fuel prefilter<br>Drain fuel prefilter (→ Page 83). |
| Intercooler | Leaking                      | Contact Service.   |

Table 12: White exhaust gas

## 6.2 Fault messages of engine governor ECU 9 for Series 1600, rail applications

### 3 – HI T-Fuel

ZKP-Number: 2.0122.931

Yellow alarm; warning

| Cause                      | Corrective action |
|----------------------------|-------------------|
| Fuel temperature too high. | ► Reduce power.   |

### 4 – SS T-Fuel (Limit 2)

ZKP-Number: 2.0122.932

Red alarm; power limitation  $\geq$  20%; forced idle

| Cause                      | Corrective action  |
|----------------------------|--|
| Fuel temperature too high. | 1. Acknowledge alarm.<br>2. Request towing locomotive if required. |

### 5 – HI T-Charge Air

ZKP-Number: 2.0121.931

Yellow alarm; warning

| Cause                            | Corrective action   |
|----------------------------------|---|
| Charge-air temperature too high. | 1. Reduce power.<br>2. If fault code number 9 is signaled at the same time, then it has priority. |

### 6 – SS T-Charge Air (Limit 2)

ZKP-Number: 2.0121.932

Yellow alarm; power limitation  $<$  20%;

| Cause                            | Corrective action   |
|----------------------------------|---|
| Charge-air temperature too high. | 1. Reduce power.<br>2. If fault code number 9 is signaled at the same time, then it has priority. |

### 9 – HI L1 T-Coolant Intercooler

ZKP-Number: 2.0124.931

Yellow alarm; warning

| Cause  | Corrective action   |
|--|---|
| Coolant temperature in intercooler too high. | 1. Reduce power.<br>2. Check engine lines for leaks. Check coolant cooler for leaks, contamination and operation. |

## 10 – SS T-Coolant Intercooler (Limit 2)

ZKP-Number: 2.0124.932

Yellow alarm; power limitation < 20%;

| Cause  | Corrective action  |
|--|--|
| Coolant temperature in intercooler too high. | <ol style="list-style-type: none"><li>1. Reduce power.</li><li>2. Check engine lines for leaks. Check coolant cooler for leaks, contamination and operation.</li><li>3. Contact Service.</li></ol> |

## 15 – LO P-Lube Oil

ZKP-Number: 2.0100.921

Yellow alarm; warning

| Cause                      | Corrective action                                   |
|----------------------------|---|
| Lube oil pressure too low. | ► Check oil level, top up as necessary (→ Page 87). |

## 16 – SS P-Lube Oil (Limit 2)

ZKP-Number: 2.0100.922

Red alarm; engine stop

| Cause                      | Corrective action   |
|----------------------------|---|
| Lube oil pressure too low. | <ol style="list-style-type: none"><li>1. Check oil level, top up as necessary (→ Page 87).</li><li>2. Acknowledge alarm.</li><li>3. Restart engine (→ Page 27).</li><li>4. Request towing locomotive if required.</li></ol> |

## 19 – HI T-Exhaust A

ZKP-Number: 2.0126.931

Yellow alarm; warning

| Cause                                      | Corrective action   |
|--|---|
| Exhaust gas temperature (A-side) too high. | <ol style="list-style-type: none"><li>1. Reduce power.</li><li>2. Check air filter.</li><li>3. Request towing locomotive if required.</li></ol> |

## 20 – SS T-Exhaust A

ZKP-Number: 2.0126.932

Red alarm; power reduction ≥ 20%

| Cause                                      | Corrective action   |
|--|---|
| Exhaust gas temperature (A-side) too high. | <ol style="list-style-type: none"><li>1. Reduce power.</li><li>2. Check air filter.</li><li>3. Request towing locomotive if required.</li></ol> |

## 21 – HI T-Exhaust B

ZKP-Number: 2.0127.931

Yellow alarm; warning

| Cause                                      | Corrective action   |
|--|---|
| Exhaust gas temperature (B-side) too high. | <ol style="list-style-type: none"><li>1. Reduce power.</li><li>2. Check air filter.</li><li>3. Request towing locomotive if required.</li></ol> |

## 22 – SS T-Exhaust B

ZKP-Number: 2.0127.932

Red alarm; power reduction  $\geq$  20%

| Cause                                      | Corrective action   |
|--|---|
| Exhaust gas temperature (B-side) too high. | <ol style="list-style-type: none"><li>1. Reduce power.</li><li>2. Check air filter.</li><li>3. Request towing locomotive if required.</li></ol> |

## 25 – HI P-Diff-Lube Oil

ZKP-Number: 2.0154.931

Yellow alarm; warning

| Cause   | Corrective action                              |
|---|--|
| Differential pressure at oil filter too high. | ► Replace oil filter ( $\rightarrow$ Page 89). |

## 26 – SS P-Diff-Lube Oil

ZKP-Number: 2.0154.932

Red alarm; power reduction  $\geq$  20%

| Cause   | Corrective action   |
|---|---|
| Differential pressure at oil filter too high. | <ol style="list-style-type: none"><li>1. Replace oil filter (<math>\rightarrow</math> Page 89).</li><li>2. Request towing locomotive if required.</li></ol> |

## 30 – SS Engine Overspeed (Limit 2)

ZKP-Number: 2.2510.932

Red alarm; engine stop

| Cause                  | Corrective action   |
|------------------------|---|
| Engine speed too high. | <ol style="list-style-type: none"><li>1. Acknowledge alarm.</li><li>2. Request towing locomotive if required.</li></ol> |

## 31 – HI ETC1 Overspeed (Limit 1)

ZKP-Number: 2.3011.931

Yellow alarm; power limitation > 20%

| Cause                          | Corrective action   |
|--------------------------------|---|
| ETC 1 (A-side) speed too high. | <ol style="list-style-type: none"><li>1. Reduce power.</li><li>2. Check air filter.</li><li>3. Check exhaust pipe visually for leaks.</li><li>4. Request towing locomotive if required.</li></ol> |

## 32 – SS ETC1 Overspeed (Limit 2)

ZKP-Number: 2.3012.932

Red alarm; power reduction ≥ 20%

| Cause                          | Corrective action   |
|--------------------------------|---|
| ETC 1 (A-side) speed too high. | <ol style="list-style-type: none"><li>1. Reduce power.</li><li>2. Check air filter.</li><li>3. Check exhaust pipe visually for leaks.</li><li>4. Request towing locomotive if required.</li></ol> |

## 33 – Hi P-Diff-Fuel

ZKP-Number: 2.0114.931

Yellow alarm; warning

| Cause                                       | Corrective action                          |
|---|--|
| Fuel filter differential pressure too high. | ► Check fuel filter, replace as necessary. |

## 34 – SS P-Diff-Fuel

ZKP-Number: 2.0114.932

No alarm, fault is entered

| Cause                                       | Corrective action                          |
|---|--|
| Fuel filter differential pressure too high. | ► Check fuel filter, replace as necessary. |

## 36 – HI ETC2 Overspeed (Limit 1)

ZKP-Number: 2.3013.931

Yellow alarm; power limitation > 20%

| Cause                          | Corrective action   |
|--------------------------------|---|
| ETC 2 (B-side) speed too high. | <ol style="list-style-type: none"><li>1. Reduce power.</li><li>2. Check air filter.</li><li>3. Check exhaust pipe visually for leaks.</li><li>4. Request towing locomotive if required.</li></ol> |

## 37 – SS ETC2 Overspeed (Limit 2)

ZKP-Number: 2.3013.912

Red alarm; power reduction ≥ 20%

| Cause                          | Corrective action   |
|--------------------------------|---|
| ETC 2 (B-side) speed too high. | <ol style="list-style-type: none"><li>1. Reduce power.</li><li>2. Check air filter.</li><li>3. Check exhaust pipe visually for leaks.</li><li>4. Request towing locomotive if required.</li></ol> |

## 51 – HI T-Lube Oil

ZKP-Number: 2.0125.931

Yellow alarm; warning

| Cause                          | Corrective action   |
|--------------------------------|---|
| Lube oil temperature too high. | <ol style="list-style-type: none"><li>1. Reduce power.</li><li>2. If fault code number 67 is signaled at the same time, then it has priority.</li></ol> |

## 52 – SS T-Lube Oil (Limit 2)

ZKP-Number: 2.0125.932

Red alarm; power reduction ≥ 20%

| Cause                          | Corrective action   |
|--------------------------------|---|
| Lube oil temperature too high. | <ol style="list-style-type: none"><li>1. Reduce power.</li><li>2. If fault code number 67 is signaled at the same time, then it has priority.</li></ol> |

## 59 – SS T-Coolant (Limit 3)

ZKP-Number: 2.0120.933

Red alarm; forced idle

| Cause                         | Corrective action  |
|-------------------------------|--|
| Coolant temperature too high. | <ol style="list-style-type: none"><li>1. Activate fan emergency operating mode if required.</li><li>2. Allow engine to cool down.</li><li>3. Check engine coolant cooler, clean if dirty.</li><li>4. Acknowledge alarm.</li><li>5. Restart engine (→ Page 27).</li><li>6. Request towing locomotive if required.</li></ol> |

## 60 – SS T-Coolant (Limit 4)

ZKP-Number: 2.0120.934

Red alarm; engine stop

| Cause                         | Corrective action  |
|-------------------------------|--|
| Coolant temperature too high. | <ol style="list-style-type: none"><li>1. Allow engine to cool down.</li><li>2. Check engine coolant cooler, clean if dirty.</li><li>3. Acknowledge alarm.</li><li>4. Restart engine (→ Page 27).</li><li>5. Activate fan emergency operating mode if required.</li><li>6. Request towing locomotive if required.</li></ol> |

## 63 – HI P-Crank Case

ZKP-Number: 2.0106.931

Red alarm; engine stop

| Cause                        | Corrective action  |
|------------------------------|--|
| Crankcase pressure too high. | <ol style="list-style-type: none"><li>1. Reduce power.</li><li>2. Acknowledge alarm.</li></ol> |

## 64 – SS P-Crank Case (Limit 2)

ZKP-Number: 2.0106.932

Red alarm; engine stop

| Cause                        | Corrective action                        |
|------------------------------|--|
| Crankcase pressure too high. | ► Request towing locomotive if required. |

## 65 – LO P-Fuel

ZKP-Number: 2.0102.921

Yellow alarm; warning

| Cause                                 | Corrective action  |
|---------------------------------------|--|
| Fuel pressure before HP pump too low. | <ol style="list-style-type: none"><li>1. Check fuel lines for leakage.</li><li>2. Drain fuel prefilter (→ Page 83).</li><li>3. Replace filter element of fuel prefilter (→ Page 84).</li><li>4. Replace fuel filter (→ Page 81).</li></ol> |

## 66 – SS P-Fuel (Low) (Limit 2)

ZKP-Number: 2.0102.922

No alarm, fault is entered

| Cause   | Corrective action  |
|---|--|
| Fuel pressure before HP pump too low. Possibly only reduced power is available. | <ol style="list-style-type: none"><li>1. Check fuel lines for leakage.</li><li>2. Drain fuel prefilter (→ Page 83).</li><li>3. Replace filter element of fuel prefilter (→ Page 84).</li><li>4. Replace fuel filter (→ Page 81).</li></ol> |

## 67 – HI T-Coolant (Limit 1)

ZKP-Number: 2.0120.931

Yellow alarm; warning

| Cause                         | Corrective action  |
|-------------------------------|--|
| Coolant temperature too high. | <ol style="list-style-type: none"><li>1. Reduce power.</li><li>2. Check engine coolant cooler, clean if dirty.</li></ol> |

## 68 – SS T-Coolant (Limit 2)

ZKP-Number: 2.0120.932

Yellow alarm; power limitation < 20%;

| Cause                         | Corrective action   |
|-------------------------------|---|
| Coolant temperature too high. | <ol style="list-style-type: none"><li>1. Activate fan emergency operating mode if required.</li><li>2. Allow engine to cool down.</li><li>3. Check engine coolant cooler, clean if dirty.</li></ol> |

## 82 – HI P-Fuel (Common Rail) (Limit 1) (in ADEC L2)

ZKP-Number: 2.0104.931

Red alarm; power reduction ≥ 20%

| Cause   | Corrective action  |
|---|--------------------|
| Rail pressure > set value; DBR fuel limitation; start of injection readjusted (retarded); HP fuel control block jamming or wiring faulty. | ► Contact Service. |

## 83 – LO P-Fuel (Common Rail) (Limit 1)

ZKP-Number: 2.0104.921

Red alarm; power reduction ≥ 20%

| Cause  | Corrective action   |
|--|---|
| Rail pressure < set value; DBR fuel limitation; HP fuel control block faulty or leakage in HP fuel system. | <ol style="list-style-type: none"><li>1. Request towing locomotive if required.</li><li>2. Contact Service.</li></ol> |

## 89 – AL Engine Speed Low (Stall < ~200 RPM)

ZKP-Number: 2.2500.030

Red alarm; engine stop

| Cause                 | Corrective action  |
|-----------------------|--|
| Engine speed too low. | <ol style="list-style-type: none"><li>1. Acknowledge alarm.</li><li>2. Restart engine (→ Page 27).</li><li>3. Observe additional messages.</li><li>4. Request towing locomotive if required.</li></ol> |

## 90 – SS Idle Speed Not Reached

ZKP-Number: 2.1090.925

Yellow alarm; warning

| Cause                   | Corrective action   |
|-------------------------|---|
| Idle speed not reached. | <ol style="list-style-type: none"><li>1. Check battery.</li><li>2. Check wiring and voltage supply.</li><li>3. Initiate new starting attempt.</li><li>4. Request towing locomotive if required.</li></ol> |

## 91 – SS Release (Run up) Speed Not Reached (< ~300 RPM)

ZKP-Number: 2.1090.924

Yellow alarm; warning

| Cause                    | Corrective action   |
|--------------------------|---|
| Runup speed not reached. | <ol style="list-style-type: none"><li>1. Check battery.</li><li>2. Check starter.</li><li>3. Initiate new starting attempt.</li><li>4. Request towing locomotive if required.</li></ol> |

## 92 – SS Starter Speed Not Reached

ZKP-Number: 2.1090.923

Yellow alarm; warning

| Cause   | Corrective action   |
|---|---|
| Starter speed not reached; termination of starting sequence; starter does not turn or turns slowly. | <ol style="list-style-type: none"><li>1. Initiate new starting attempt.</li><li>2. Check voltage at starter power supply.</li><li>3. Request towing locomotive if required.</li></ol> |

## 93 – SS T-Preheat

ZKP-Number: 2.1090.922

No alarm, fault is entered

| Cause  | Corrective action  |
|--|--|
| Preheating temperature too low; coolant temperature too low for engine start. Significantly increased engine wear. Engine start might be inhibited by the locomotive control system. Engine may be started in emergency situations only. | <ol style="list-style-type: none"><li>1. Extend preheating period.</li><li>2. Check preheating unit.</li></ol> |

## 94 – LO T-Preheat

ZKP-Number: 2.1090.921

Yellow alarm; warning

| Cause  | Corrective action   |
|--|---|
| Preheating temperature too low; coolant temperature too low for engine start. Excessive engine wear. Engine start might be inhibited by the locomotive control system. Engine may be started in emergency situations only. | 1. Extend preheating period.<br>2. Check preheating unit. |

## 102 – AL Fuel Cons. Counter Defect

ZKP-Number: 1.8004.624

Yellow alarm; warning

| Cause                     | Corrective action            |
|---------------------------|------------------------------|
| Consumption meter faulty. | ► Replace consumption meter. |

## 104 – AL Eng Hours Counter Defect

ZKP-Number: 1.8004.623

Yellow alarm; warning

| Cause              | Corrective action     |
|--------------------|-----------------------|
| Hour meter faulty. | ► Replace hour meter. |

## 118 – LO ECU Power Supply Voltage

ZKP-Number: 2.0140.921

Yellow alarm; warning

| Cause                   | Corrective action                       |
|-------------------------|---|
| Supply voltage too low. | ► Check engine governor supply voltage. |

## 119 – LOLO ECU Power Supply Voltage (Limit 2)

ZKP-Number: 2.0140.922

Red alarm; engine stop

| Cause                   | Corrective action  |
|-------------------------|--|
| Supply voltage too low. | 1. Check engine governor supply voltage.<br>2. Acknowledge alarm.<br>3. Restart engine (→ Page 27).<br>4. Request towing locomotive if required. |

## 120 – HI ECU Power Supply Voltage

ZKP-Number: 2.0140.931

Yellow alarm; warning

| Cause                    | Corrective action                       |
|--------------------------|---|
| Supply voltage too high. | ► Check engine governor supply voltage. |

## 121 – HIHI ECU Power Supply Voltage (Limit 2)

ZKP-Number: 2.0140.932

Red alarm; engine stop

| Cause                    | Corrective action   |
|--------------------------|---|
| Supply voltage too high. | <ol style="list-style-type: none"><li>1. Check engine governor supply voltage.</li><li>2. Acknowledge alarm.</li><li>3. Restart engine (→ Page 27).</li><li>4. Request towing locomotive if required.</li></ol> |

## 122 – HI T-ECU

ZKP-Number: 2.0132.921

Yellow alarm; warning

| Cause                                 | Corrective action  |
|---------------------------------------|--|
| Electronic unit temperature too high. | <ol style="list-style-type: none"><li>1. Reduce power.</li><li>2. Observe following faults, e.g. LT Intercooler.</li></ol> |

## 180 – AL CAN1 Node Lost

ZKP-Number: 2.0500.680

Yellow alarm; warning

| Cause                                     | Corrective action  |
|---|--|
| Connection to a node on CAN bus 1 failed. | <ol style="list-style-type: none"><li>1. Check devices connected to CAN.</li><li>2. Check wiring (2x121Ω terminating resistor available?).</li><li>3. Contact Service.</li></ol> |

## 181 – AL CAN2 Node Lost

ZKP-Number: 2.0500.681

Yellow alarm; warning

| Cause                                     | Corrective action  |
|---|--|
| Connection to a node on CAN bus 2 failed. | <ol style="list-style-type: none"><li>1. Check devices connected to CAN.</li><li>2. Check wiring (2x121Ω terminating resistor available?).</li><li>3. Contact Service.</li></ol> |

## 182 – AL CAN Wrong Parameters

ZKP-Number: 2.0500.682

Yellow alarm; warning

| Cause  | Corrective action  |
|--|--------------------|
| Incorrect parameter values entered in data record. | ► Contact Service. |

## 183 – AL CAN No PU-Data

ZKP-Number: 2.0500.683

Yellow alarm; warning

| Cause   | Corrective action   |
|---|---|
| The selected CAN mode initializes communication by means of the PU data module. However, the required PU data module is not available or not valid. | 1. Check devices connected to CAN.<br>2. Contact Service. |

## 184 – AL CAN PU-Data Flash Error

ZKP-Number: 2.0500.684

Yellow alarm; warning

| Cause   | Corrective action              |
|---|--------------------------------|
| A programming error occurred when attempting to copy a received PU data module into the Flash module. | ► Contact Electronics Service. |

## 186 – AL CAN1 Bus Off

ZKP-Number: 2.0500.686

Yellow alarm; warning

| Cause                                    | Corrective action  |
|--|--|
| CAN controller 1 is in "Bus-Off" status. | 1. Check CAN bus for short circuit, rectify short circuit as necessary.<br>2. Check shielding, improve shielding as necessary. |

## 187 – AL CAN1 Error Passive

ZKP-Number: 2.0500.687

Yellow alarm; warning

| Cause                                    | Corrective action  |
|--|--|
| CAN controller 1 has signaled a warning. | 1. Check CAN bus for short circuit, rectify short circuit as necessary.<br>2. Check shielding, improve shielding as necessary. |

## 188 – AL CAN2 Bus Off

ZKP-Number: 2.0500.688

Yellow alarm; warning

| Cause   | Corrective action   |
|---|---|
| CAN controller 2 is in "Bus-Off" status. Automatic changeover to CAN 1; short circuit; massive interference or baud rate incompatibility. | <ol style="list-style-type: none"><li>1. Check CAN bus for short circuit, rectify short circuit as necessary.</li><li>2. Check shielding, improve shielding as necessary.</li></ol> |

## 189 – AL CAN2 Error Passive

ZKP-Number: 2.0500.689

Yellow alarm; warning

| Cause                                    | Corrective action   |
|--|---|
| CAN controller 2 has signaled a warning. | <ol style="list-style-type: none"><li>1. Check CAN bus for short circuit, rectify short circuit as necessary.</li><li>2. Check shielding, improve shielding as necessary.</li></ol> |

## 201 – SD T-Coolant

ZKP-Number: 1.8004.570

Yellow alarm; power limitation < 20%;

| Cause   | Corrective action   |
|---|---|
| Coolant temperature sensor faulty; short circuit or wire break. | ► Check sensors B6.1, B6.3, and cabling , replace if necessary<br>(→ Page 109). |

## 203 – SD T-Charge Air

ZKP-Number: 1.8004.571

Yellow alarm; power limitation < 20%;

| Cause  | Corrective action   |
|--|---|
| Charge-air temperature sensor faulty; short circuit or wire break. | ► Check sensors B9.1, B9.2, B9.3, and cabling , replace if necessary<br>(→ Page 109). |

## 204 – SD Level Lube Oil

ZKP-Number: 1.8004.602

Optional yellow alarm; warning

| Cause  | Corrective action  |
|--|--|
| Lube oil level sensor faulty; short circuit or wire break. | ► Check sensor B93 and wiring, replace as necessary<br>(→ Page 109). |

## 205 – SD T-Coolant Intercooler

ZKP-Number: 1.8004.574

Yellow alarm; warning

| Cause   | Corrective action  |
|---|--|
| Intercooler coolant temperature sensor faulty; short circuit or wire break. | ► Check sensor B26 and wiring, replace as necessary<br>(→ Page 109). |

## 206 – SD T-Exhaust A

ZKP-Number: 1.8004.576

Yellow alarm; warning

| Cause   | Corrective action  |
|---|--|
| Exhaust temperature sensor on A-side faulty; short circuit or wire break. | ► Check sensor B4.21 and wiring, replace as necessary<br>(→ Page 109). |

## 207 – SD T-Exhaust B

ZKP-Number: 1.8004.577

Yellow alarm; warning

| Cause   | Corrective action  |
|---|--|
| Exhaust temperature sensor on B-side faulty; short circuit or wire break. | ► Check sensor B4.22 and wiring, replace as necessary<br>(→ Page 109). |

## 208 – SD P-Charge Air

ZKP-Number: 1.8004.566

Yellow alarm; power limitation < 20%;

| Cause   | Corrective action  |
|---|--|
| Charge-air pressure sensor faulty; short circuit or wire break. | ► Check sensor B10 and wiring, replace as necessary<br>(→ Page 109). |

## 211 – SD P-Lube Oil

ZKP-Number: 1.8004.563

Yellow alarm; power limitation < 20%;

| Cause   | Corrective action   |
|---|---|
| Lube oil pressure sensor faulty; short circuit or wire break. | ► Check sensors B5.1, B5.3, and cabling , replace if necessary<br>(→ Page 109). |

## 214 – SD P-CrankCase

ZKP-Number: 1.8004.568

Yellow alarm; warning

| Cause  | Corrective action  |
|--|--|
| Crankcase pressure sensor faulty; short circuit or wire break. | ► Check sensor B50 and wiring, replace as necessary<br>(→ Page 109). |

## 215 – SD P-HD High Pressure Fuel

ZKP-Number: 1.8004.567

Yellow alarm; power limitation < 20%;

| Cause   | Corrective action   |
|---|---|
| Rail pressure sensor faulty; high-pressure regulator emergency mode; short circuit or wire break. | ► Check sensors B48.1, B48.2, and cabling , replace if necessary<br>(→ Page 109). |

## 216 – SD T-Lube Oil

ZKP-Number: 1.8004.575

Yellow alarm; warning

| Cause  | Corrective action   |
|--|---|
| Lube oil temperature sensor faulty; short circuit or wire break. | ► Check sensor B7 and wiring, replace as necessary<br>(→ Page 109). |

## 219 – SD T-Intake Air

ZKP-Number: 1.8004.573

Yellow alarm; warning

| Cause  | Corrective action  |
|--|--|
| Intake air temperature sensor faulty; short circuit or wire break. | ► Check sensor B90 and wiring, replace as necessary<br>(→ Page 109). |

## 221 – SD Dif Lube Oil

ZKP-Number: 1.8004.585

Yellow alarm; warning

| Cause  | Corrective action  |
|--|--|
| Lube oil pressure differential sensor faulty; short circuit or wire break. | ► Check sensor B93 and wiring, replace as necessary<br>(→ Page 109). |

## 227 – SD P-Lube Oil before Filter

ZKP-Number: 1.8004.620

Yellow alarm; warning

| Cause   | Corrective action   |
|---|---|
| Sensor for lube oil pressure before filter faulty; short circuit or wire break. | ► Check sensor B5.3 and wiring, replace as necessary<br>(→ Page 109). |

## 228 – SD P-Fuel before Filter

ZKP-Number: 1.8004.595

Yellow alarm; warning

| Cause   | Corrective action  |
|---|--|
| Fuel pressure sensor faulty; short circuit or wire break. | ► Check sensor B34.2 and wiring, replace as necessary<br>(→ Page 109). |

## 229 – AL Stop Camshaft and Crankshaft Sensor Defect

ZKP-Number: 1.8004.562

Red alarm; engine stop

| Cause  | Corrective action  |
|--|--|
| Engine stop due to camshaft sensor fault and a previous crankshaft sensor fault in the same operating cycle. | 1. Check sensor and wiring to connectors B1 and B13, replace as necessary (→ Page 109).<br>2. Acknowledge alarm.<br>3. Restart engine (→ Page 27). |

## 230 – SD Crankshaft Speed

ZKP-Number: 1.8004.498

Yellow alarm; power limitation < 20%;

| Cause  | Corrective action  |
|--|--|
| Crankshaft sensor faulty; short circuit or wire break. | ► Check sensor B13 and wiring, replace as necessary<br>(→ Page 109). |

## 231 – SD Camshaft Speed

ZKP-Number: 1.8004.499

Yellow alarm; warning

| Cause  | Corrective action   |
|--|---|
| Camshaft sensor faulty; short circuit or wire break. | ► Check sensor B1 and wiring, replace as necessary<br>(→ Page 109). |

## 232 – SD Charger 1 Speed

ZKP-Number: 1.3011.128

Yellow alarm; warning

| Cause   | Corrective action  |
|---|--|
| Speed sensor of primary turbocharger faulty; short circuit or wire break. | ► Check sensor B44.1 and wiring, replace as necessary<br>(→ Page 109). |

## 233 – SD Charger 2 Speed

ZKP-Number: 1.3011.129

Yellow alarm; warning

| Cause   | Corrective action  |
|---|--|
| Speed sensor of primary turbocharger faulty; short circuit or wire break. | ► Check sensor B44.2 and wiring, replace as necessary<br>(→ Page 109). |

## 239 – SD P-Diff Fuel

ZKP-Number: 1.8004.598

Yellow alarm; warning

| Cause  | Corrective action   |
|--|---|
| Pressure sensors for differential fuel pressure faulty; short circuit or wire break.<br>Fault only occurs in connection. | ► Check sensors B34.1, B34.2, and cabling , replace if necessary<br>(→ Page 109). |

## 240 – SD P-Fuel

ZKP-Number: 1.8004.565

Yellow alarm; warning

| Cause   | Corrective action   |
|---|---|
| Fuel pressure sensor after fuel main filter defective; short circuit or wire break. | ► Check sensors B34.1, B34.2, and cabling , replace if necessary<br>(→ Page 109). |

## 245 – SD ECU Power Supply Voltage

ZKP-Number: 2.8006.589

Yellow alarm; warning

| Cause   | Corrective action          |
|---|----------------------------|
| Internal engine governor fault; electronics faulty. | ► Replace engine governor. |

## 266 – SD Speed Demand

ZKP-Number: 2.8006.586

Red alarm; forced idle

| Cause   | Corrective action   |
|---|---|
| Analog nominal speed setting faulty; short circuit or wire break. | <ol style="list-style-type: none"><li>1. Check wiring (→ Page 109).</li><li>2. Check speed setting.</li><li>3. Contact Service.</li></ol> |

## 270 – SD Frequency Input

ZKP-Number: 2.8006.590

Red alarm; forced idle

| Cause  | Corrective action  |
|--|--|
| Frequency input faulty; short circuit or wire break. | <ol style="list-style-type: none"><li>1. Check wiring (→ Page 109).</li><li>2. Check setpoint speed transmitter.</li><li>3. Contact Service.</li></ol> |

## 321 – AL Wiring Cylinder A1

ZKP-Number: 1.8004.520

Yellow alarm; warning

| Cause   | Corrective action       |
|---|-------------------------|
| Short circuit in cylinder injector wiring. Result: Misfiring. | ► Check solenoid valve. |

## 322 – AL Wiring Cylinder A2

ZKP-Number: 1.8004.521

Yellow alarm; warning

| Cause   | Corrective action       |
|---|-------------------------|
| Short circuit in cylinder injector wiring. Result: Misfiring. | ► Check solenoid valve. |

## 323 – AL Wiring Cylinder A3

ZKP-Number: 1.8004.522

Yellow alarm; warning

| Cause   | Corrective action       |
|---|-------------------------|
| Short circuit in cylinder injector wiring. Result: Misfiring. | ► Check solenoid valve. |

## 324 – AL Wiring Cylinder A4

ZKP-Number: 1.8004.523

Yellow alarm; warning

| Cause   | Corrective action       |
|---|-------------------------|
| Short circuit in cylinder injector wiring. Result: Misfiring. | ► Check solenoid valve. |

## 325 – AL Wiring Cylinder A5

ZKP-Number: 1.8004.524

Yellow alarm; warning

| Cause   | Corrective action       |
|---|-------------------------|
| Short circuit in cylinder injector wiring. Result: Misfiring. | ► Check solenoid valve. |

## 326 – AL Wiring Cylinder A6

ZKP-Number: 1.8004.525

Yellow alarm; warning

| Cause   | Corrective action       |
|---|-------------------------|
| Short circuit in cylinder injector wiring. Result: Misfiring. | ► Check solenoid valve. |

## 331 – AL Wiring Cylinder B1

ZKP-Number: 1.8004.530

Yellow alarm; warning

| Cause   | Corrective action       |
|---|-------------------------|
| Short circuit in cylinder injector wiring. Result: Misfiring. | ► Check solenoid valve. |

## 332 – AL Wiring Cylinder B2

ZKP-Number: 1.8004.531

Yellow alarm; warning

| Cause   | Corrective action       |
|---|-------------------------|
| Short circuit in cylinder injector wiring. Result: Misfiring. | ► Check solenoid valve. |

## 333 – AL Wiring Cylinder B3

ZKP-Number: 1.8004.532

Yellow alarm; warning

| Cause   | Corrective action       |
|---|-------------------------|
| Short circuit in cylinder injector wiring. Result: Misfiring. | ► Check solenoid valve. |

## 334 – AL Wiring Cylinder B4

ZKP-Number: 1.8004.533

Yellow alarm; warning

| Cause   | Corrective action       |
|---|-------------------------|
| Short circuit in cylinder injector wiring. Result: Misfiring. | ► Check solenoid valve. |

## 335 – AL Wiring Cylinder B5

ZKP-Number: 1.8004.534

Yellow alarm; warning

| Cause   | Corrective action       |
|---|-------------------------|
| Short circuit in cylinder injector wiring. Result: Misfiring. | ► Check solenoid valve. |

## 336 – AL Wiring Cylinder B6

ZKP-Number: 1.8004.535

Yellow alarm; warning

| Cause   | Corrective action       |
|---|-------------------------|
| Short circuit in cylinder injector wiring. Result: Misfiring. | ► Check solenoid valve. |

## 341 – AL Open Load Cylinder A1

ZKP-Number: 1.8004.540

Yellow alarm; warning

| Cause  | Corrective action       |
|--|-------------------------|
| Open circuit in cylinder injector wiring. Result: Misfiring. | ► Check solenoid valve. |

## 342 – AL Open Load Cylinder A2

ZKP-Number: 1.8004.541

Yellow alarm; warning

| Cause  | Corrective action       |
|--|-------------------------|
| Open circuit in cylinder injector wiring. Result: Misfiring. | ► Check solenoid valve. |

## 343 – AL Open Load Cylinder A3

ZKP-Number: 1.8004.542

Yellow alarm; warning

| Cause  | Corrective action       |
|--|-------------------------|
| Open circuit in cylinder injector wiring. Result: Misfiring. | ► Check solenoid valve. |

## 344 – AL Open Load Cylinder A4

ZKP-Number: 1.8004.543

Yellow alarm; warning

| Cause  | Corrective action       |
|--|-------------------------|
| Open circuit in cylinder injector wiring. Result: Misfiring. | ► Check solenoid valve. |

## 345 – AL Open Load Cylinder A5

ZKP-Number: 1.8004.544

Yellow alarm; warning

| Cause  | Corrective action       |
|--|-------------------------|
| Open circuit in cylinder injector wiring. Result: Misfiring. | ► Check solenoid valve. |

## 346 – AL Open Load Cylinder A6

ZKP-Number: 1.8004.545

Yellow alarm; warning

| Cause  | Corrective action       |
|--|-------------------------|
| Open circuit in cylinder injector wiring. Result: Misfiring. | ► Check solenoid valve. |

## 351 – AL Open Load Cylinder B1

ZKP-Number: 1.8004.550

Yellow alarm; warning

| Cause  | Corrective action       |
|--|-------------------------|
| Open circuit in cylinder injector wiring. Result: Misfiring. | ► Check solenoid valve. |

## 352 – AL Open Load Cylinder B2

ZKP-Number: 1.8004.551

Yellow alarm; warning

| Cause  | Corrective action       |
|--|-------------------------|
| Open circuit in cylinder injector wiring. Result: Misfiring. | ► Check solenoid valve. |

## 353 – AL Open Load Cylinder B3

ZKP-Number: 1.8004.552

Yellow alarm; warning

| Cause  | Corrective action       |
|--|-------------------------|
| Open circuit in cylinder injector wiring. Result: Misfiring. | ► Check solenoid valve. |

## 354 – AL Open Load Cylinder B4

ZKP-Number: 1.8004.553

Yellow alarm; warning

| Cause  | Corrective action       |
|--|-------------------------|
| Open circuit in cylinder injector wiring. Result: Misfiring. | ► Check solenoid valve. |

## 355 – AL Open Load Cylinder B5

ZKP-Number: 1.8004.554

Yellow alarm; warning

| Cause  | Corrective action       |
|--|-------------------------|
| Open circuit in cylinder injector wiring. Result: Misfiring. | ► Check solenoid valve. |

## 356 – AL Open Load Cylinder B6

ZKP-Number: 1.8004.555

Yellow alarm; warning

| Cause  | Corrective action       |
|--|-------------------------|
| Open circuit in cylinder injector wiring. Result: Misfiring. | ► Check solenoid valve. |

## 361 – AL Power Stage Low (Internal Electronic Failure)

ZKP-Number: 1.8004.496

Red alarm; engine stop

| Cause   | Corrective action  |
|---|--|
| Internal electronic fault, electronics possibly faulty. | <ol style="list-style-type: none"><li>1. Observe any other messages.</li><li>2. Check solenoid valve wiring (→ Page 109).</li><li>3. Acknowledge alarm.</li><li>4. Restart engine (→ Page 27).</li><li>5. Request towing locomotive if required.</li></ol> |

## 362 – AL Power Stage High (Internal Electronic Failure)

ZKP-Number: 1.8004.497

Red alarm; engine stop

| Cause   | Corrective action  |
|---|--|
| Internal electronic fault, electronics possibly faulty. | <ol style="list-style-type: none"><li>1. Observe any other messages.</li><li>2. Check solenoid valve wiring (→ Page 109).</li><li>3. Acknowledge alarm.</li><li>4. Restart engine (→ Page 27).</li><li>5. Request towing locomotive if required.</li></ol> |

## 363 – AL Stop Power Stage

ZKP-Number: 1.8004.560

Red alarm; engine stop

| Cause   | Corrective action  |
|---|--|
| Internal electronic fault, electronics possibly faulty. | <ol style="list-style-type: none"><li>1. Check wiring (→ Page 109).</li><li>2. Acknowledge alarm.</li><li>3. Restart engine.</li><li>4. Request towing locomotive if required.</li></ol> |

## 365 – AL Stop MV-Wiring Ground (Injector Amplifier Ground)

ZKP-Number: 1.8004.561

Red alarm; engine stop

| Cause                  | Corrective action  |
|------------------------|--|
| Injector wiring fault. | <ol style="list-style-type: none"><li>1. Check wiring (→ Page 109).</li><li>2. Acknowledge alarm.</li><li>3. Restart engine.</li><li>4. Request towing locomotive if required.</li></ol> |

## 381 – AL Wiring TOP 1

ZKP-Number: 2.8006.638

Yellow alarm; warning

| Cause  | Corrective action                     |
|--|---------------------------------------|
| Short circuit or wire break on transistor output 1 plant-side 1 (TOP 1). | ► Check wiring to plant (→ Page 109). |

## 382 – AL Wiring TOP 2

ZKP-Number: 2.8006.639

Yellow alarm; warning

| Cause  | Corrective action                     |
|--|---------------------------------------|
| Short circuit or wire break on transistor output 2 plant-side (TOP 2). | ► Check wiring to plant (→ Page 109). |

## 383 – AL Wiring TOP 3

ZKP-Number: 2.8006.640

Yellow alarm; warning

| Cause  | Corrective action                     |
|--|---------------------------------------|
| Short circuit or wire break on transistor output 3 plant-side (TOP 3). | ► Check wiring to plant (→ Page 109). |

## 384 – AL Wiring TOP 4

ZKP-Number: 2.8006.641

Yellow alarm; warning

| Cause  | Corrective action                     |
|--|---------------------------------------|
| Short circuit or wire break on transistor output 4 plant-side (TOP 4). | ► Check wiring to plant (→ Page 109). |

## 408 – AL Open Load Emerg. Stop Input ESI

ZKP-Number: 2.8006.633

Yellow alarm; warning

| Cause  | Corrective action  |
|--|--|
| Line disruption on the input for emergency stop; wiring defective or no resistance through the switch. | 1. Check wiring (→ Page 109).<br>2. Check target device input. |

## 410 – LO U-PDU (Low Injector Voltage) (Limit 1)

ZKP-Number: 2.0141.921

Yellow alarm; warning

| Cause                     | Corrective action                                 |
|---------------------------|---|
| Injector voltage too low. | 1. Check wiring (→ Page 109).<br>2. Check supply. |

## 411 – LOLO U-PDU (Injector Voltage) (Limit 2)

ZKP-Number: 2.0141.922

Red alarm; engine stop

| Cause                     | Corrective action   |
|---------------------------|---|
| Injector voltage too low. | 1. Check wiring (→ Page 109).<br>2. Check supply.<br>3. Acknowledge alarm.<br>4. Restart engine.<br>5. Request towing locomotive if required. |

## 412 – HI U-PDU (High Injector Voltage) (Limit 1)

ZKP-Number: 2.0141.931

Yellow alarm; warning

| Cause                      | Corrective action                                 |
|----------------------------|---|
| Injector voltage too high. | 1. Check wiring (→ Page 109).<br>2. Check supply. |

## 413 – HIHI U-PDU (Injector Voltage) (Limit 2)

ZKP-Number: 2.0141.932

Red alarm; engine stop

| Cause                      | Corrective action   |
|----------------------------|---|
| Injector voltage too high. | <ol style="list-style-type: none"><li>1. Check wiring (→ Page 109).</li><li>2. Check supply.</li><li>3. Acknowledge alarm.</li><li>4. Restart engine.</li><li>5. Request towing locomotive if required.</li></ol> |

## 414 – HI Level Water Fuel Prefilter

ZKP-Number: 2.0156.931

Yellow alarm; warning

| Cause                                   | Corrective action       |
|---|-------------------------|
| Water level in fuel prefILTER too high. | ► Empty fuel prefILTER. |

## 417 – SD Level Water Fuel Prefilter

ZKP-Number: 1.8004.594

Yellow alarm; warning

| Cause   | Corrective action                                |
|---|--|
| Water level sensor of fuel prefILTER faulty; short circuit or wire break. | ► Check sensor and wiring, replace as necessary. |

## 422 – SD T-Charge Air B

ZKP-Number: 2.0130.605

Yellow alarm; warning

| Cause  | Corrective action  |
|--|--|
| Charge-air temperature sensor faulty; Short circuit or wire break. | ► Check sensor B10.11 and wiring, replace as necessary (→ Page 109). |

## 438 – LO P-Fuel 2 (Common Rail)

ZKP-Number: 2.0116.921

Red alarm; power reduction ≥ 20%

| Cause   | Corrective action  |
|---|--------------------|
| Rail pressure below specified value; DBR reduction.<br>HP fuel control block faulty or leakage in HP fuel system. | ► Contact Service. |

## 439 – HI P-Fuel 2 (Common Rail)

ZKP-Number: 2.0116.931

Red alarm; power reduction  $\geq$  20%

| Cause   | Corrective action  |
|---|--------------------|
| Rail pressure above specified value; DBR reduction.<br>HP fuel control block faulty, short circuit or wire break. | ► Contact Service. |

## 441 – AL Rail 2 Leakage

ZKP-Number: 1.8004.047

Yellow alarm; warning

| Cause  | Corrective action  |
|--|--------------------|
| Pressure gradient in rail is too low during starting or too high during stopping.<br>HP system leaky, air in system. | ► Contact Service. |

## 444 – SD U-PDU (Injector Voltage)

ZKP-Number: 1.8004.578

Yellow alarm; warning

| Cause  | Corrective action          |
|--|----------------------------|
| Injector power stage sensor defect; internal fault in engine governor. | ► Replace engine governor. |

## 446 – SD P-HD2

ZKP-Number: 1.8004.599

Yellow alarm; power limitation  $<$  20%;

| Cause   | Corrective action   |
|---|---|
| Rail pressure sensor faulty, high-pressure regulator emergency mode; short circuit or wire break. | ► Check sensor B48 and wiring, replace as necessary (→ Page 109). |

## 450 – SD Idle/End-Torque Input [%]

ZKP-Number: 2.8006.592

Red alarm; forced idle

| Cause  | Corrective action  |
|--|--|
| Input signal for initial/final torque faulty; short circuit or wire break. | 1. Check signal transmitter and cabling, replace as necessary.<br>2. Restart engine (→ Page 27). |

## 454 – SS Power Reduction Active

ZKP-Number: 2.7000.011

CAN message

| Cause   | Corrective action   |
|---|---|
| Alarm is only available as a separate CAN message, power reduction is active. | <ol style="list-style-type: none"><li>1. Observe any other messages.</li><li>2. Determine and rectify cause of power reduction.</li></ol> |

## 467 – AL L2 T-Aux 1

ZKP-Number: 2.0130.922

Red alarm; engine stop

| Cause   | Corrective action  |
|---|--|
| Temperature signal from Aux 1 violated limit value 2. | <ol style="list-style-type: none"><li>1. Check wiring (→ Page 109).</li><li>2. Acknowledge alarm.</li><li>3. Restart engine.</li><li>4. Request towing locomotive if required.</li></ol> |

## 470 – SD T-ECU

ZKP-Number: 1.8004.587

Yellow alarm; warning

| Cause   | Corrective action   |
|---|---|
| Temperature sensor for engine governor faulty; short circuit or wire break. | ► Check sensor and wiring, replace as necessary (→ Page 109). |

## 471 – SD Coil Current (High Pressure Pump suction valve)

ZKP-Number: 1.8004.592

Yellow alarm; warning

| Cause   | Corrective action   |
|---|---|
| Control of HP fuel control block faulty; short circuit or wire break. | ► Check sensor and wiring, replace as necessary (→ Page 109). |

## 474 – AL Wiring FO

ZKP-Number: 2.8006.655

Yellow alarm; warning

| Cause                                      | Corrective action            |
|--|------------------------------|
| Line break or short circuit at FO channel. | ► Check wiring (→ Page 109). |

## 476 – AL Crash Rec. Init. Error (Occurs when ADEC has power)

ZKP-Number: 1.8010.007

Yellow alarm; warning

| Cause                                   | Corrective action            |
|---|------------------------------|
| Initialization error of crash recorder. | ► Check setting with DiaSys. |

## 478 – AL Comb. Alarm Yel (Plant)

ZKP-Number: 2.8006.001

Yellow alarm; warning

| Cause                              | Corrective action             |
|------------------------------------|-------------------------------|
| Combined alarm initiated by plant. | ► Observe any other messages. |

## 479 – AL Comb. Alarm Red (Plant)

ZKP-Number: 2.8006.002

Red alarm

| Cause                              | Corrective action             |
|------------------------------------|-------------------------------|
| Combined alarm initiated by plant. | ► Observe any other messages. |

## 500 – AL Wiring POM Starter 1

ZKP-Number: 1.4500.900

Yellow alarm; warning

| Cause  | Corrective action                           |
|--|---|
| A cabling fault in connection of starter 1 to POM has been detected. This may be due to a missing consumer, wire break or a short circuit. | ► Check connection between POM and starter. |

## 501 – AL Wiring POM Starter 2

ZKP-Number: 1.4500.901

Yellow alarm; warning

| Cause  | Corrective action                           |
|--|---|
| A cabling fault in connection of starter 2 to POM has been detected. This may be due to a missing consumer, wire break or a short circuit. | ► Check connection between POM and starter. |

## 502 – AL Open Load POM Alternator

ZKP-Number: 1.4500.902

Yellow alarm; warning

| Cause  | Corrective action  |
|--|--|
| A line interruption was detected at the battery-charging generator connection for the POM. | ► Check connection between POM and battery-charging generator. |

## 503 – AL Battery Not Charging

ZKP-Number: 1.4500.903

Yellow alarm; warning

| Cause   | Corrective action   |
|---|---|
| Battery is not charged by battery-charging generator. | ► Check battery-charging generator and wiring (→ Page 109). |

## 504 – AL CAN POM Node Lost

ZKP-Number: 1.4500.904

Yellow alarm; warning

| Cause                   | Corrective action           |
|-------------------------|-----------------------------|
| POM missing on CAN bus. | ► Check connection and POM. |

## 506 – AL Low Starter Voltage

ZKP-Number: 1.4500.906

Yellow alarm; warning

| Cause  | Corrective action                                |
|--|--|
| The battery voltage is too low for the starting process. | ► Check starter battery and wiring (→ Page 109). |

## 507 – AL POM Error

ZKP-Number: 1.4500.907

Yellow alarm; warning

| Cause                         | Corrective action |
|-------------------------------|-------------------|
| A general POM fault occurred. | ► Replace POM.    |

## 508 – AL Wrong POM-ID

ZKP-Number: 1.4500.908

Yellow alarm; warning

| Cause  | Corrective action           |
|--|-----------------------------|
| POM sends a different ID number than expected. | ► Check POM wiring harness. |

## 510 – AL Override applied

ZKP-Number: 2.7002.010

No alarm, fault is entered

| Cause                 | Corrective action      |
|-----------------------|------------------------|
| Override Acknowledged | ► Deactivate Override. |

## 515 – Al Starter Not Engaged

ZKP-Number: 2.1090.926

Yellow alarm; warning

| Cause  | Corrective action  |
|--|--|
| Starter on POM could not be engaged. If the number of admissible automatic starting attempts is executed, the starting sequence is terminated. | 1. Repeat start.<br>2. Check POM, starter and wiring (→ Page 109). |

## 519 – Oillevel Calibration Error (optional)

ZKP-Number: 1.0158.921

Yellow alarm; warning

| Cause   | Corrective action   |
|---|---|
| Error writing calibration value into flash or SD of level sensor. | ► Check sensor and wiring, replace as necessary (→ Page 109). |

## 536 – AL Wiring PWM\_CM1

ZKP-Number: 1.1041.921

Yellow alarm; warning

| Cause   | Corrective action   |
|---|---|
| Wire break or short circuit on channel PWM_CM1. | ► Check wiring to connected device or check connected device (actuator/sensor), replace if necessary. |

## 549 – AL Power Cut-Off detected

ZKP-Number: 2.7001.952

Yellow alarm; warning

| Cause   | Corrective action  |
|---|--|
| The operating voltage of the engine governor was switched off with the engine running. This may lead to overpressure in the HP fuel system, which might cause damage to the engine. | ► Instruct the operator only to disconnect the power supply when the engine has stopped. |

## 551 – SS Engine Overspeed Camshaft

ZKP-Number: 2.2510.933

Red alarm; engine stop

| Cause                        | Corrective action  |
|------------------------------|--|
| Engine overspeed of camshaft | <ol style="list-style-type: none"><li>1. Acknowledge alarm.</li><li>2. Restart engine (→ Page 27).</li><li>3. Request towing locomotive if required.</li></ol> |

## 558 – AL Wiring PWM\_CM2

ZKP-Number: 1.1041.922

Yellow alarm; warning

| Cause   | Corrective action   |
|---|---|
| Wire break or short circuit on channel PWM_CM2. | ► Check wiring to connected device or check connected device (actuator/sensor), replace if necessary. |

## 593 – AL T-Lube Oil Pan Low (Option)

ZKP-Number: 2.1090.929

Yellow alarm; warning

| Cause  | Corrective action  |
|--|--|
| T-Lube Oil Pan has violated the limit value (too cold); significantly increased engine wear. Engine start might be inhibited by the locomotive control system. | <ol style="list-style-type: none"><li>1. Extend preheating period.</li><li>2. Request towing locomotive if required.</li><li>3. Move locomotive into heated hall if necessary.</li></ol> |

## 594 – AL L1 UDV Defekt Rail 1

ZKP-Number: 1.1301.900

Yellow alarm; warning

| Cause                                       | Corrective action                                    |
|---|--|
| Pressure relief valve of first rail faulty. | ► Check pressure relief valve, replace as necessary. |

## 595 – AL L2 UDV Defekt Rail 1

ZKP-Number: 1.1301.901

No alarm, fault is entered

| Cause                                       | Corrective action                                    |
|---|--|
| Pressure relief valve of first rail faulty. | ► Check pressure relief valve, replace as necessary. |

## 596 – AL Develop PR Set

ZKP-Number: 1.8004.645

Yellow alarm; warning

| Cause   | Corrective action  |
|---|--------------------|
| Standard production data record available. The data record stored is for testing. | ► Contact Service. |

## 598 – AL L1 UDV Defekt Rail 2

ZKP-Number: 1.1302.900

Yellow alarm; warning

| Cause  | Corrective action                                    |
|--|--|
| Pressure relief valve of second rail faulty. | ► Check pressure relief valve, replace as necessary. |

## 599 – AL L2 UDV Defekt Rail 2

ZKP-Number: 1.1302.901

No alarm, fault is entered

| Cause  | Corrective action                                    |
|--|--|
| Pressure relief valve of second rail faulty. | ► Check pressure relief valve, replace as necessary. |

## 600 – SD T-Exhaust A+B

ZKP-Number: 1.8004.646

Red alarm; power reduction  $\geq 20\%$

| Cause   | Corrective action   |
|---|---|
| Exhaust temperature sensor on A and B sides defective; short circuit or wire break. | ► Check sensors B4.21, B4.22, and cabling , replace if necessary. |

## 602 – AL CAN Engine Start Lock

ZKP-Number: 2.1090.930

Yellow alarm; warning

| Cause                               | Corrective action  |
|-------------------------------------|--|
| Start interlock initiated by plant. | <ol style="list-style-type: none"><li>1. Check plant configuration.</li><li>2. Restart engine (→ Page 27).</li><li>3. Request towing locomotive if required.</li></ol> |

## 606 – AL Double Nodes Lost CAN 1+2

ZKP-Number: 2.0500.691

Red alarm; forced idle

| Cause                                  | Corrective action   |
|--|---|
| No communication between ADEC and PAU. | <ol style="list-style-type: none"><li>1. Check wiring and power supply of plant.</li><li>2. Acknowledge alarm.</li><li>3. Restart engine (→ Page 27).</li><li>4. Request towing locomotive if required.</li></ol> |

## 608 – AL Wiring PWM\_CM6

ZKP-Number: 1.1041.926

No alarm, fault is entered

| Cause   | Corrective action   |
|---|---|
| Wire break or short circuit on channel PWM_CM6. | ► Check wiring to connected device or check connected device (actuator/sensor), replace if necessary. |

## 609 – AL Wiring PWM\_CM7

ZKP-Number: 1.1041.927

Yellow alarm; warning

| Cause   | Corrective action   |
|---|---|
| Wire break or short circuit on channel PWM_CM7. | ► Check wiring to connected device or check connected device (actuator/sensor), replace if necessary. |

## 626 – AL Wiring PWM\_CM8

ZKP-Number: 1.1041.928

No alarm, fault is entered

| Cause   | Corrective action   |
|---|---|
| Wire break or short circuit on channel PWM_CM8. | ► Check wiring to connected device or check connected device (actuator/sensor), replace if necessary. |

## 627 – AL Wiring PWM\_CM9

ZKP-Number: 1.1041.929

No alarm, fault is entered

| Cause   | Corrective action   |
|---|---|
| Wire break or short circuit on channel PWM_CM9. | ► Check wiring to connected device or check connected device (actuator/sensor), replace if necessary. |

## 628 – AL Wiring PWM\_CM10

ZKP-Number: 1.1041.930

Yellow alarm; warning

| Cause  | Corrective action   |
|--|---|
| Wire break or short circuit on channel PWM_CM10. | ► Check wiring to connected device or check connected device (actuator/sensor), replace if necessary. |

## 629 – AL AGR Throttle A Defect

ZKP-Number: 1.0700.011

Yellow alarm; warning

| Cause  | Corrective action           |
|--|-----------------------------|
| Actuator at EGR shutoff flap A or flap mechanism faulty. | ► Replace actuator or flap. |

## 630 – AL AGR Throttle B Defect

ZKP-Number: 1.0700.031

Yellow alarm; warning

| Cause  | Corrective action           |
|--|-----------------------------|
| Actuator at EGR shutoff flap B or flap mechanism faulty. | ► Replace actuator or flap. |

## 631 – AL Bypass Throttle Defect

ZKP-Number: 1.0700.051

Yellow alarm; warning

| Cause   | Corrective action           |
|---|-----------------------------|
| Actuator at bypass flap or flap mechanism faulty. | ► Replace actuator or flap. |

## 633 – SD P-Ambient Air (HDT2800)

ZKP-Number: 1.0700.087

Yellow alarm; warning

| Cause   | Corrective action                                    |
|---|--|
| Humirel HDT2800 CAN sensor faulty; short circuit or wire break. | ► Check sensor B90 and wiring, replace as necessary. |

## 634 – SD TO-Ambient Air (HDT2800)

ZKP-Number: 1.0700.089

Yellow alarm; warning

| Cause  | Corrective action                                    |
|--|--|
| TO ambient air HDT2800 CAN temperature sensor faulty; short circuit or wire break. | ► Check sensor B90 and wiring, replace as necessary. |

## 635 – SD Air Humidity (HDT2800)

ZKP-Number: 1.0700.091

Yellow alarm; warning

| Cause  | Corrective action                                    |
|--|--|
| Air humidity CAN sensor faulty; short circuit or wire break. | ► Check sensor B90 and wiring, replace as necessary. |

## 636 – SD Level Lube Oil J1939

ZKP-Number: 1.0700.105

Yellow alarm; warning

| Cause  | Corrective action                                |
|--|--|
| CAN lube oil level sensor faulty; short circuit or wire break. | ► Check sensor and wiring, replace as necessary. |

## 637 – SD T-Lube Oil Pan J1939

ZKP-Number: 1.0700.107

Yellow alarm; warning

| Cause   | Corrective action                                |
|---|--|
| Oil pan CAN temperature sensor faulty; short circuit or wire break. | ► Check sensor and wiring, replace as necessary. |

## 640 – SD Smart NOx Oxidation Factor O2

ZKP-Number: 1.0700.145

No alarm, fault is entered

| Cause   | Corrective action   |
|---|---|
| Smart NOx sensor (oxidation factor O2) faulty; short circuit or wire break. | ► Check sensors B88.1, B88.2, and cabling , replace if necessary. |

## 647 – SD P-Exhaust Lambda

ZKP-Number: 1.0163.900

Yellow alarm; warning

| Cause   | Corrective action   |
|---|---|
| Exhaust pressure sensor near lambda sensor faulty; short circuit or wire break. | 1. Check sensor B91.3 and wiring, replace as necessary.<br>2. Restart engine (→ Page 27). |

## 648 – SD P-Charge Air B

ZKP-Number: 1.0149.900

Yellow alarm; power limitation < 20%;

| Cause   | Corrective action   |
|---|---|
| Charge-air pressure sensor on B-side faulty; short circuit or wire break. | 1. Check sensor B10 and wiring, replace as necessary.<br>2. Restart engine (→ Page 27). |

## 662 – SD Smart NOx Heater Element

ZKP-Number: 1.0700.141

Yellow alarm; warning

| Cause   | Corrective action   |
|---|---|
| SD Smart NOx heating element faulty; short circuit or wire break. | ► Check sensors B88.1, B88.2, and cabling , replace if necessary. |

## 663 – SD Smart NOx Concentration

ZKP-Number: 1.0700.143

Yellow alarm; warning

| Cause   | Corrective action   |
|---|---|
| Smart NOx sensor (NOx concentration) faulty; short circuit or wire break. | ► Check sensors B88.1, B88.2, and cabling , replace if necessary. |

## 727 – AL L1 Delta T-NT Intercooler

ZKP-Number: 2.1075.901

Yellow alarm; warning

| Cause                                   | Corrective action  |
|---|--|
| T-Max. Coolant Intercooler Exceeded L1. | 1. Reduce power.<br>2. Check intercooler and coolant cooler.<br>3. Check charge-air coolant circuit. |

## 728 – AL L2 Delta T-NT Intercooler

ZKP-Number: 2.1075.903

No alarm, fault is entered

| Cause                                   | Corrective action  |
|---|--|
| T-Max. Coolant Intercooler Exceeded L2. | <ol style="list-style-type: none"><li>1. Reduce power.</li><li>2. Check intercooler and coolant cooler.</li><li>3. Check charge-air coolant circuit.</li></ol> |

## 745 – AL Emission Fault

ZKP-Number: 2.1600.004

Red alarm; power reduction  $\geq$  20%

| Cause           | Corrective action   |
|-----------------|---|
| Emission fault. | <ol style="list-style-type: none"><li>1. Reduce power.</li><li>2. Check sensors and wiring.</li></ol> |

## 754 – SD Bosch LSU Lambda Sensor

ZKP-Number: 1.0800.990

Yellow alarm; warning

| Cause                           | Corrective action                                |
|---------------------------------|--|
| Bosch LSU lambda sensor faulty. | ► Check sensor and wiring, replace as necessary. |

## 757 – AL Lim T-Coolant NT-Fan

ZKP-Number: 2.2800.900

Yellow alarm; warning

| Cause   | Corrective action  |
|---|--|
| Charge-air cooler coolant has exceeded limit value. | <ol style="list-style-type: none"><li>1. Check coolant level, top up if necessary.</li><li>2. Check thermostat.</li><li>3. Check air filter.</li></ol> |

## 796 – AL HI T-Charge Air B

ZKP-Number: 2.0146.931

Yellow alarm; warning

| Cause                            | Corrective action  |
|----------------------------------|--|
| Charge-air temperature too high. | <ol style="list-style-type: none"><li>1. Reduce power.</li><li>2. If fault code number 9 is signaled at the same time, then it has priority.</li></ol> |

## 797 – AL HIHI T-Charge Air B

ZKP-Number: 2.0146.932

Yellow alarm; power limitation < 20%;

| Cause                            | Corrective action  |
|----------------------------------|--|
| Charge-air temperature too high. | <ol style="list-style-type: none"><li>1. Reduce power.</li><li>2. If fault code number 9 is signaled at the same time, then it has priority.</li></ol> |

## 806 – SD Charger 3 Speed

ZKP-Number: 1.3010.901

Yellow alarm; warning

| Cause   | Corrective action   |
|---|---|
| Speed sensor of secondary turbocharger faulty; short circuit or wire break. | ► Check sensor B44.3 and wiring, replace as necessary (→ Page 109). |

## 807 – SD Charger 4 Speed

ZKP-Number: 1.3010.903

Yellow alarm; warning

| Cause   | Corrective action   |
|---|---|
| Speed sensor of secondary turbocharger faulty; short circuit or wire break. | ► Check sensor B44.4 and wiring, replace as necessary (→ Page 109). |

## 832 – AL EIL Different Engine Number

ZKP-Number: 1.0610.953

Yellow alarm; warning

| Cause                             | Corrective action |
|-----------------------------------|-------------------|
| Different EIL engine number alarm | ► -               |

## 833 – AL Emission Warning

ZKP-Number: 2.1600.008

Yellow alarm; warning

| Cause                   | Corrective action  |
|-------------------------|--|
| Emission warning alarm. | <ol style="list-style-type: none"><li>1. Check flap control.</li><li>2. Check sensors.</li></ol> |

## 834 – AL Gas Path Warning

ZKP-Number: 2.1600.010

Yellow alarm; warning

| Cause                   | Corrective action                           |
|-------------------------|---|
| Gas path warning alarm. | 1. Check flap control.<br>2. Check sensors. |

## 835 – AL Gas Path Fault

ZKP-Number: 2.1600.012

Red alarm; power reduction  $\geq$  20%

| Cause                 | Corrective action                           |
|-----------------------|---|
| Gas path fault alarm. | 1. Check flap control.<br>2. Check sensors. |

## 843 – SD T-Charge Air before AGR

ZKP-Number: 1.0147.920

Yellow alarm; warning

| Cause  | Corrective action  |
|--|--|
| Charge-air temperature sensor faulty; short circuit or wire break. | ► Check sensor B9.1 and wiring, replace as necessary<br>( $\rightarrow$ Page 109). |

## 844 – AL HI T-Charge Air before AGR

ZKP-Number: 2.0147.931

Yellow alarm; warning

| Cause                            | Corrective action |
|----------------------------------|-------------------|
| Charge-air temperature too high. | ► Reduce power.   |

## 845 – AL HIHI T-Charge Air before AGR

ZKP-Number: 2.0147.932

Red alarm; power limitation  $\geq$  20%; forced idle

| Cause                            | Corrective action  |
|----------------------------------|--|
| Charge-air temperature too high. | 1. Reduce power.<br>2. Acknowledge alarm.<br>3. Request towing locomotive if required. |

## 851 – External Start and HD too high

ZKP-Number: 1.1026.901

Red alarm; power reduction  $\geq$  20%

| Cause | Corrective action |
|-------|-------------------|
| -     | ► -               |

## 855 – AL Bypass Throttle 2 Defect

ZKP-Number: 1.0700.841

Yellow alarm; warning

| Cause   | Corrective action           |
|---|-----------------------------|
| Actuator at bypass flap or flap mechanism faulty. | ► Replace actuator or flap. |

## 872 – AL EGR A Fast learn failed

ZKP-Number: 1.0700.021

Yellow alarm; warning

| Cause | Corrective action |
|-------|-------------------|
| xxxxx | ► xxx             |

## 876 – AL EGR B Fast learn failed

ZKP-Number: 1.0700.040

Yellow alarm; warning

| Cause | Corrective action |
|-------|-------------------|
| xxxxx | ► xxx             |

## 877 – AL Bypass A Fast learn failed

ZKP-Number: 1.0700.060

Yellow alarm; warning

| Cause | Corrective action |
|-------|-------------------|
| xxxxx | ► xxx             |

## 878 – AL Bypass B Fast learn failed

ZKP-Number: 1.0700.851

Yellow alarm; warning

| Cause | Corrective action |
|-------|-------------------|
| xxxxx | ► xxx             |

# 7 Task Description

## 7.1 Valve Drive

### 7.1.1 Valve clearance - Check and adjustment

#### Preconditions

- Engine is stopped and starting disabled.
- Engine coolant temperature is max. 40 °C.
- Valves are closed.

#### Special tools, Material, Spare parts

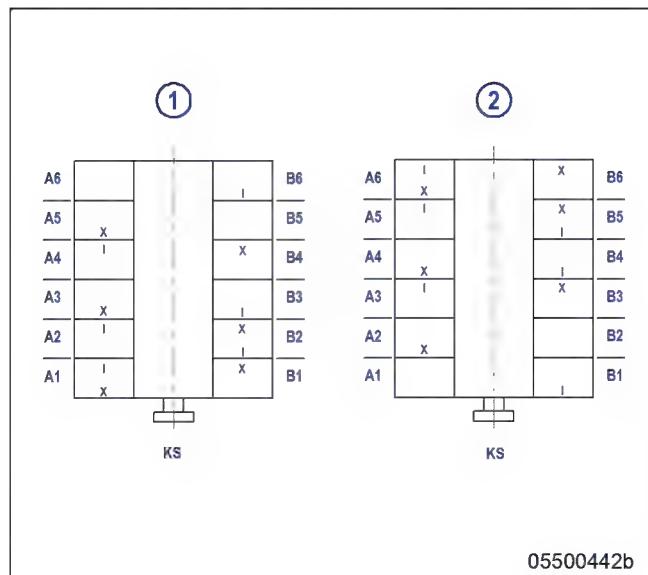
| Designation / Use        | Part No.  | Oty. |
|--------------------------|-----------|------|
| Feeler gage              | Y20010128 | 1    |
| Torque wrench, 20-100 Nm | F30026582 | 1    |
| Box wrench, 14 mm        | F30028346 | 1    |
| Allen key, 5 mm          | F30002815 | 1    |
| Barring gear             | F6790714  | 1    |

#### Preparatory steps

1. Remove cylinder head cover (→ Page 78).
2. Remove cover on the bottom of flywheel housing, A side.
3. Install barring gear at opening.
4. Rotate crankshaft with barring gear in engine direction of rotation until “OT-A1” mark and pointer are aligned.

#### Diagram for 12V engines (two crankshaft positions)

- 1 Cylinder A1 is in firing TDC
- 2 Cylinder A1 is in overlap TDC
- I Inlet valve
- X Exhaust valve

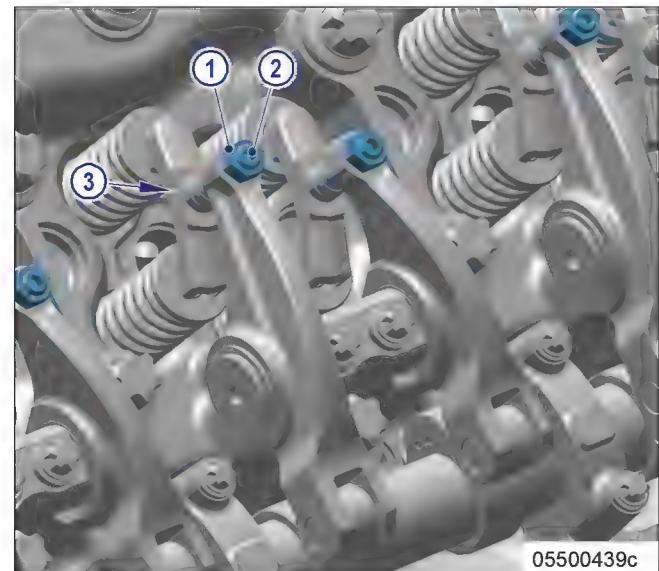


## Checking valve clearance at two crankshaft positions

1. Check TDC position of piston in cylinder A1:
  - If the rocker arms are unloaded on cylinder A1, the piston is in firing TDC.
  - If the rocker arms are under load on cylinder A1, the piston is in overlap TDC.
2. Check valve clearance with cold engine:
  - Inlet = 0.3 +/- 0.05 mm;
  - Exhaust = 0.6 +/- 0.05 mm.
3. Check all valve clearances in two crankshaft positions (firing TDC and overlap TDC of cylinder A1) as per diagram.
4. Use feeler gage to determine the distance between valve bridge and rocker arm.
5. If the deviation from the reference value exceeds 0.1 mm, adjust valve clearance.

## Adjusting valve clearance

1. Loosen locknut (1) and unscrew adjusting screw (2) by a few threads.
2. Insert feeler gage between valve bridge and rocker arm (3).
3. Readjust adjusting screw (2) so that the feeler gage just passes through the gap.



4. Tighten locknut (1) to specified torque using a torque wrench, holding adjusting screw (2) firm with Allen key.

| Name | Size    | Type              | Lubricant | Value/Standard |
|------|---------|-------------------|-----------|----------------|
| Nut  | M10 x 1 | Tightening torque |           | 43 Nm +4 Nm    |

5. Check if the feeler gage just passes through between valve bridge and rocker arm (3).

Result: If not, adjust valve clearance.

## Final steps

1. Remove barring gear.
2. Install cover.
3. Install cylinder head cover (→ Page 78).

## 7.1.2 Cylinder head cover – Removal and installation

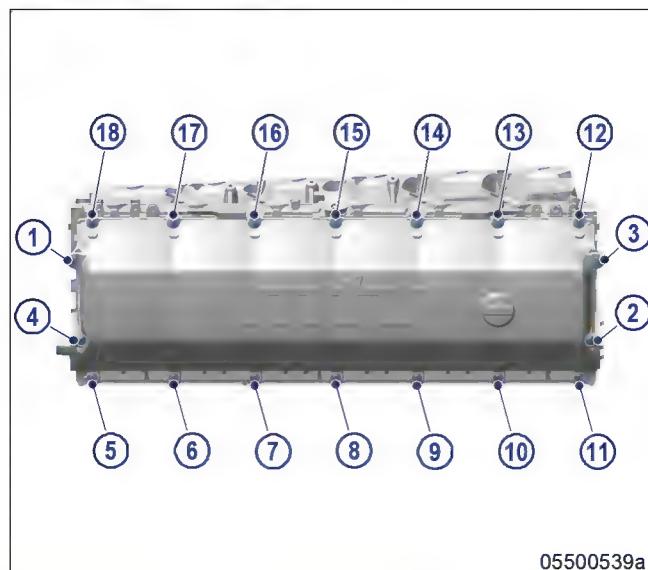
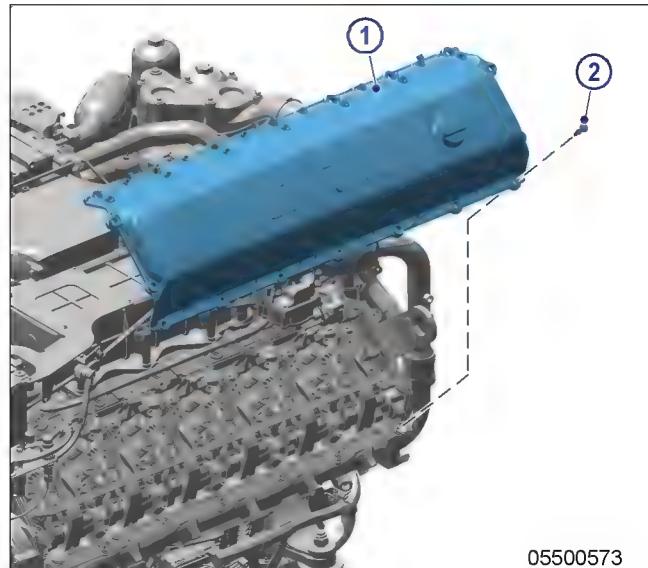
### Preconditions

Engine is stopped and starting disabled.

### Removing and installing cylinder head cover

Note: Cover the engine beneath the cylinder head with rags to soak up escaping residual oil.

1. Remove screws (2).
2. Remove cylinder head cover (1).
3. Clean mating faces.
4. Check condition of profile gasket and replace if required.



5. Position cylinder head cover and screws at positions 1 to 4 and tighten to specified initial tightening torque using a torque wrench.

| Name                   | Size | Type           | Lubricant | Value/Standard |
|------------------------|------|----------------|-----------|----------------|
| Screw with twin collar | M8   | Preload torque |           | 10 Nm          |

6. Tighten screws at positions 1 to 18 to specified torque using a torque wrench.

| Name  | Size | Type              | Lubricant | Value/Standard   |
|---|------|-------------------|-----------|------------------|
| Screw with twin collar                                  | M8   | Tightening torque |           | 20 Nm $\pm 2$ Nm |
| Consecutive tightening sequence starting at position 1: |      |                   |           | 1 to 18          |

## 7.2 Fuel System

### 7.2.1 Fuel system - Venting

#### Preconditions

- Engine is stopped and starting disabled.
- Engine cooled down to ambient temperature.

#### Special tools, Material, Spare parts

| Designation / Use      | Part No.  | Qty. |
|------------------------|-----------|------|
| Torque wrench, 4-20 Nm | F30044239 | 1    |
| Ratchet                | F30027340 | 1    |

**WARNING**



Fuels are combustible.

**Risk of fire and explosion!**

- Avoid open flames, electrical sparks and ignition sources.
- Do not smoke.

#### Venting fuel prefilter

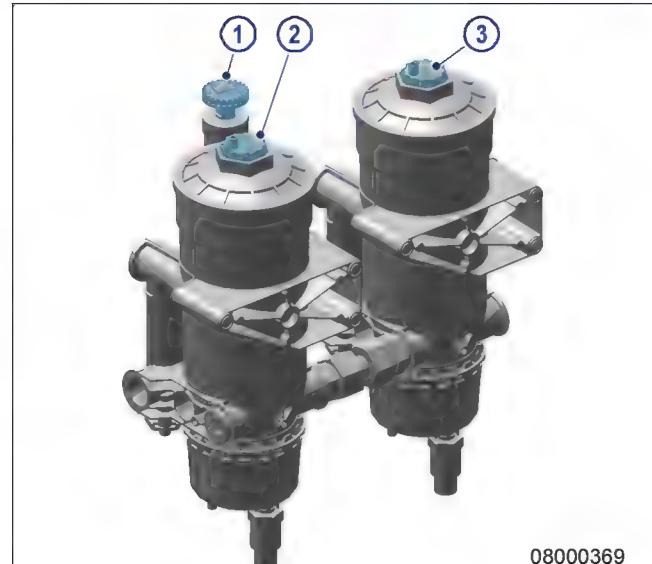
1. Unlock fuel priming pump, screw out handle (1).

Note: Catch emerging fuel with a suitable cloth.

2. Loosen threaded vent plug (2) and screw out by approx. 3 to 4 turns.
3. Operate the pump with the handle (1) until bubble-free fuel emerges from the vent plug (2).
4. Close threaded vent plug (2) and tighten by hand.

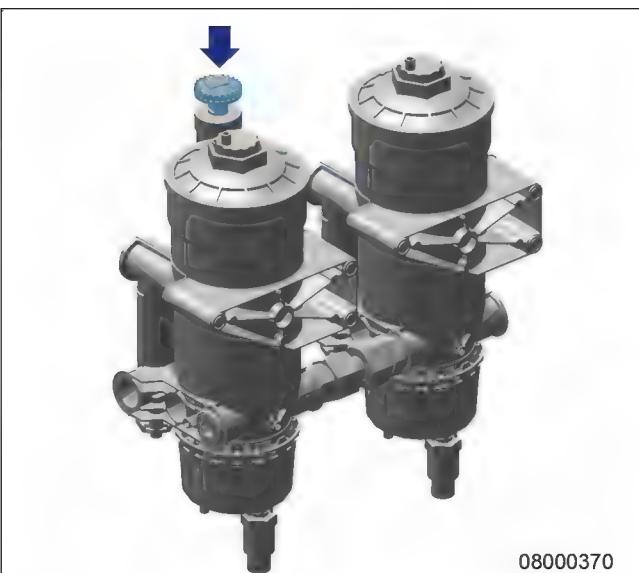
Note: Catch emerging fuel with a suitable cloth.

5. Loosen threaded vent plugs (3) and screw out by approx. 3 to 4 turns.
6. Operate the pump with the handle (1) until bubble-free fuel emerges from the vent plug (2).
7. Close threaded vent plug (2) and tighten by hand.



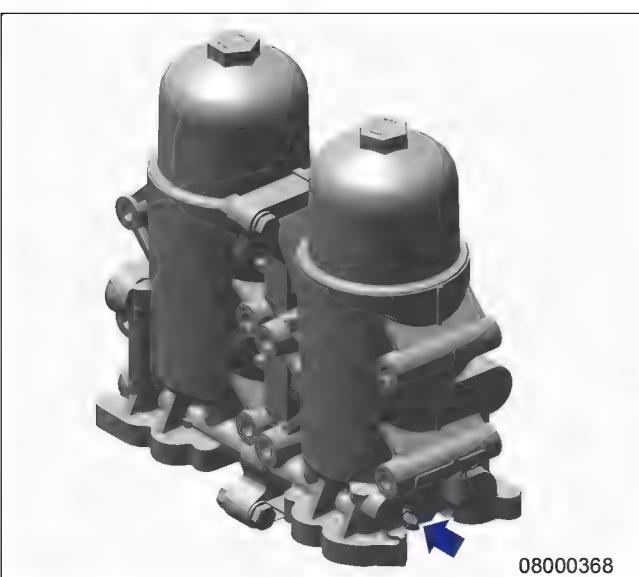
## Venting fuel filter

1. Unlock fuel priming pump, unscrew handle (arrow).



2. Provide a suitable container in which to collect the fuel.

Note: Do not remove threaded vent plug.  
3. Open threaded vent plug (arrow).



4. Screw in threaded vent plug (arrowed) and tighten to specified torque using a torque wrench.

| Name               | Size | Type              | Lubricant | Value/Standard      |
|--------------------|------|-------------------|-----------|---------------------|
| Threaded vent plug | 10   | Tightening torque |           | 6.5 Nm $\pm 1.3$ Nm |

## 7.3 Fuel Filter

### 7.3.1 Fuel filter – Replacement

#### Preconditions

- Engine is stopped and starting disabled.
- Engine cooled down to ambient temperature.

#### Special tools, Material, Spare parts

| Designation / Use       | Part No.                | Qty. |
|-------------------------|-------------------------|------|
| Torque wrench, 4-20 Nm  | F30044239               | 1    |
| Torque wrench, 10-60 Nm | F30510423               | 1    |
| Ratchet                 | F30027340               | 1    |
| Socket, 32 mm           | F30006120               | 1    |
| Engine oil              |                         |      |
| Fuel filter element     | (→ Spare Parts Catalog) | 2    |

#### WARNING



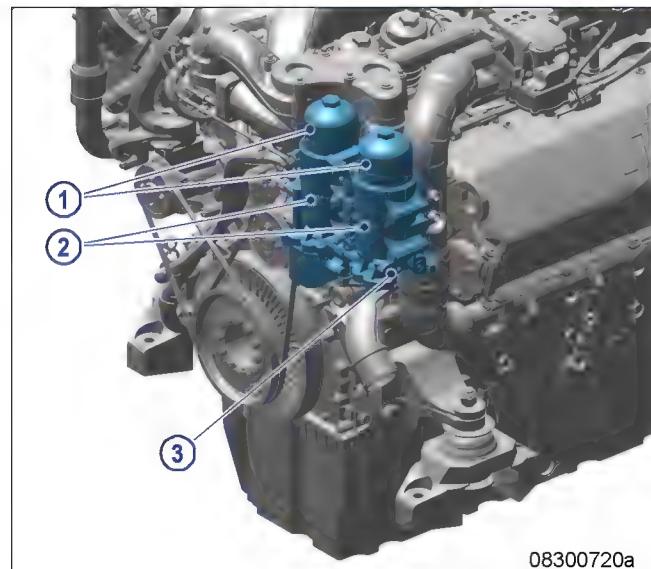
Fuels are combustible.

#### Risk of fire and explosion!

- Avoid open flames, electrical sparks and ignition sources.
- Do not smoke.

#### Fuel filter – Replacement

1. Unscrew drain screw (3).
2. Loosen screw cap (1) on fuel filter and unscrew it approx. 3 to 4 turns.
3. Wait 10 minutes, until fuel emerges from filter housing (2).
4. Unscrew threaded cover (1).
5. Unscrew fuel filter element.
6. Check condition of the sealing ring on the screw cap (1).
7. Replace damaged sealing ring.
8. Coat sealing ring with engine oil.
9. Screw in new fuel filter element in filter housing (2) and tighten by hand.



08300720a

10. Screw threaded cover (1) onto filter housing (2) and use torque wrench to tighten to the specified torque.

| Name  | Size   | Type              | Lubricant    | Value/Standard   |
|-------|--------|-------------------|--------------|------------------|
| Cover | 32 A/F | Tightening torque | (Engine oil) | 40 Nm $\pm$ 5 Nm |

11. Screw in drain plug (3) and tighten with torque wrench to the specified tightening torque.

| Name       | Size | Type              | Lubricant | Value/Standard      |
|------------|------|-------------------|-----------|---------------------|
| Drain plug | 10   | Tightening torque |           | 6.5 Nm $\pm$ 1.3 Nm |

12. Vent fuel system (→ Page 79).

### 7.3.2 Fuel prefilter – Drain condensate

#### Preconditions

- Engine is stopped and starting disabled.

**WARNING**



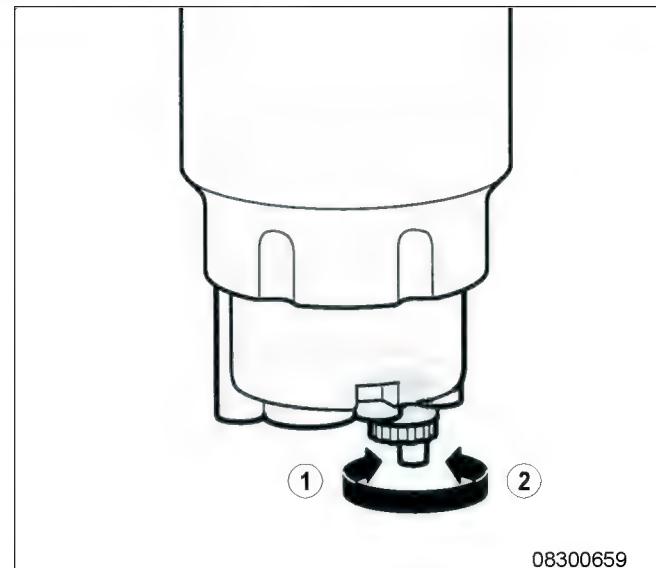
Fuels are combustible.

**Risk of fire and explosion!**

- Avoid open flames, electrical sparks and ignition sources.
- Do not smoke.

#### Draining condensate from fuel prefilter

1. Provide a suitable container to collect the water.
2. Open drain screw (1).
3. Allow water to drain off.
4. Screw in and close drain screw (2).



08300659

### 7.3.3 Fuel prefilter – Filter element replacement

#### Preconditions

Engine is stopped and starting disabled.

#### Special tools, Material, Spare parts

| Designation / Use      | Part No.                | Qty. |
|------------------------|-------------------------|------|
| Torque wrench, 6-50 Nm | F30027336               | 1    |
| Ratchet                | F30027340               | 1    |
| Diesel fuel            |                         |      |
| Filter element         | (→ Spare Parts Catalog) |      |
| Sealing ring           | (→ Spare Parts Catalog) |      |

#### WARNING



Fuels are combustible.

#### Risk of fire and explosion!

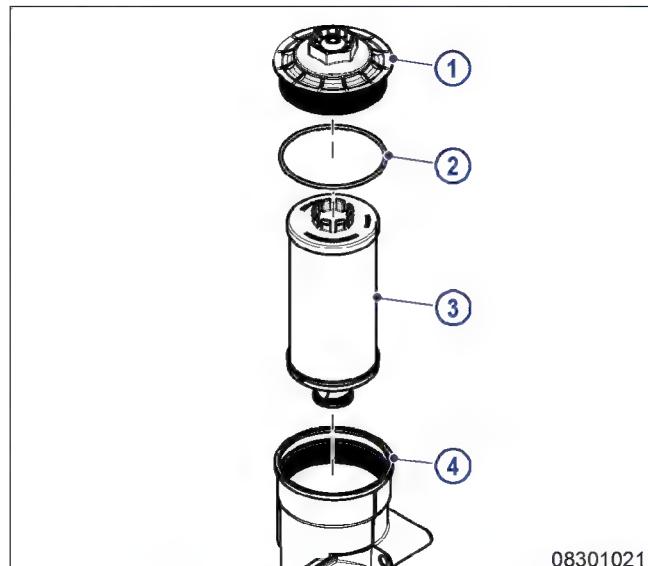
- Avoid open flames, electrical sparks and ignition sources.
- Do not smoke.

#### Preparatory step

► Provide a suitable container in which to collect the fuel.

#### Replacing fuel prefilter

1. Close fuel supply.
2. Unscrew filter cover (1).
3. Remove filter cover (1) with filter element (3) from filter housing.
4. Remove filter element (3) from filter cover (1).
5. Install new O-ring (2) on filter cover (1).
6. Coat new O-ring (2) with fuel.
7. Insert new filter element (3) in filter cover (1).
8. Screw in filter cover (1) with filter element (3) into filter housing.



9. Tighten filter cover (1) to specified torque using a torque wrench.

| Numm         | Stm | Type              | Lubricant | Valne/Standard |
|--------------|-----|-------------------|-----------|----------------|
| Filter cover |     | Tightening torque |           | 40 Nm          |

10. Open fuel supply.

## 7.4 Air Filter

### 7.4.1 Air filter - Replacement

#### **Preconditions**

Engine is stopped and starting disabled.

**For air filter replacement, carry out operations as specified by the manufacturer – filter is plant/vehicle manufacturer's supply.**

## 7.5 Air Intake

### 7.5.1 Service indicator - Signal ring position check

#### Preconditions

Engine is stopped and starting disabled.

#### Checking signal ring position

1. Replace air filter, if the signal ring (2) is completely visible in the red area of the service indicator control window (3) (→ Page 85).
2. After installation of new filter, press reset button (1).

Result: Signal ring returns to initial position.



## 7.6 Lube Oil System, Lube Oil Circuit

### 7.6.1 Engine oil level - Check

#### Preconditions

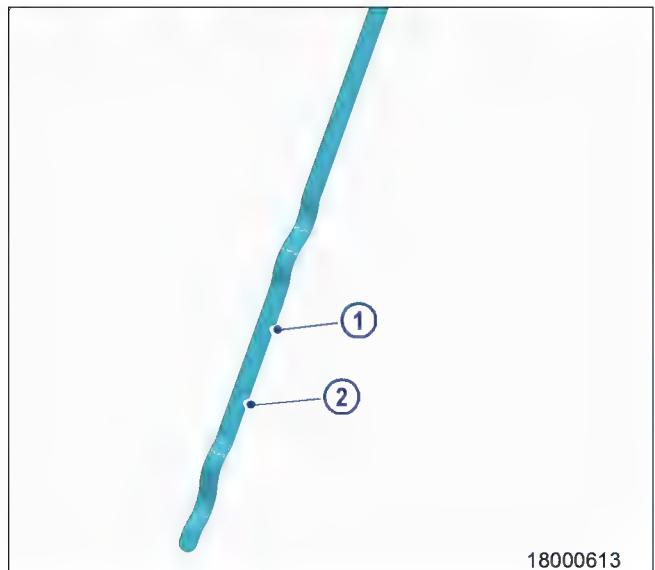
- Engine is stopped and starting disabled.

#### Checking oil level prior to engine start

1. Withdraw oil dipstick (arrow) from guide tube and wipe it.
2. Insert oil dipstick (arrow) into guide tube up to the stop, withdraw after approx. 10 seconds and check oil level.



3. Oil level must be between "min." (2) and "max." (1) marks.
4. If necessary, top up to the "max." (2) mark (→ Page 88).
5. Insert oil dipstick (1) in guide tube up to the stop.



#### Checking oil level after the engine is stopped

1. 5 minutes after stopping the engine, remove oil dipstick (1) from the guide tube and wipe it.
2. Insert oil dipstick (1) into guide tube up to the stop, withdraw after approx. 10 seconds and check oil level.
3. Oil level must be between "min." and "max." marks.
4. If necessary, top up to "max." mark (→ Page 88).
5. Insert oil dipstick (1) in guide tube up to the stop.

## 7.6.2 Engine oil - Change

### Preconditions

- Engine is stopped and starting disabled.
- Engine is at operating temperature.
- MTU Fluids and Lubricants Specifications (A001063/..) are available.

### Special tools, Material, Spare parts

| Designation / Use | Part No. | Oty. |
|-------------------|----------|------|
| Engine oil        |          |      |

#### WARNING



Hot oil.

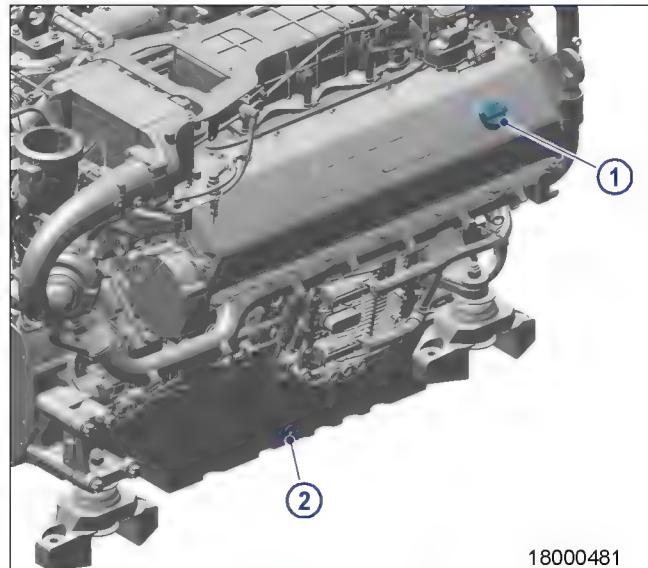
Oil can contain combustion residues which are harmful to health.

#### Risk of injury and poisoning!

- Wear protective clothing, gloves, and goggles / safety mask.
- Avoid contact with skin.
- Do not inhale oil vapor.

### Draining oil via drain plug on oil pan

1. Provide a suitable container to collect the oil.
2. Remove drain plug (2) and drain oil.



3. Insert drain plug (2) and use torque wrench to tighten to specified tightening torque.

| Name       | Size    | Type              | Lubricant    | Value/Standard |
|------------|---------|-------------------|--------------|----------------|
| Drain plug | M26x1.5 | Tightening torque | (Engine oil) | 100 Nm         |

4. Replace engine oil filter (→ Page 89).

### Filling with new oil

1. Open cap (1) on cylinder head cover.
2. Fill with oil, oil quantity (→ Page 21).
3. Close cap (1) on cylinder head cover.
4. Check engine oil level (→ Page 87).

## 7.7 Oil Filtration / Cooling

### 7.7.1 Engine oil filter – Replacement

#### Preconditions

Engine is stopped and starting disabled.

#### Special tools, Material, Spare parts

| Designation / Use       | Part No.                | Dty. |
|-------------------------|-------------------------|------|
| Torque wrench, 10-60 Nm | F30510423               | 1    |
| Ratchet                 | F30027340               | 1    |
| Socket, 32 mm           | F30006120               | 1    |
| Engine oil              |                         |      |
| Oil filter element      | (→ Spare Parts Catalog) |      |

#### WARNING



Hot oil.

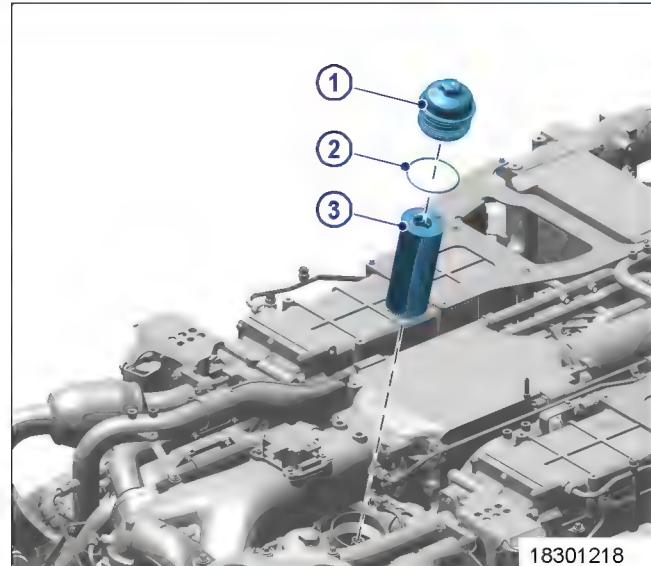
Oil can contain combustion residues which are harmful to health.

#### Risk of injury and poisoning!

- Wear protective clothing, gloves, and goggles / safety mask.
- Avoid contact with skin.
- Do not inhale oil vapor.

#### Engine oil filter – Replacement

1. Unscrew the oil filter covers (1) approx. 3 to 4 revolutions.
2. Wait 10 minutes until the oil has drained from the filter housings.
3. Take off threaded cover (1) with oil filter element (3).
4. Pull oil filter element (3) to detach it from threaded cover (1).
5. Check condition of sealing ring (2) on cover.
6. Replace sealing ring (2) if damaged.
7. Coat sealing ring (2) with oil.
8. Insert new oil filter element (3) in cover (1) and press in until it locks in place.



9. Screw on cover (1) with oil filter element (3) and tighten to specified torque using a torque wrench.

| Name  | Size   | Type              | Lubricant    | Value/Standard |
|-------|--------|-------------------|--------------|----------------|
| Cover | 32 A/F | Tightening torque | (Engine oil) | 35 Nm ±3.5 Nm  |

10. Replace other engine oil filters in the same way.
11. Check oil level (→ Page 87)

## 7.8 Coolant Circuit, General, High-Temperature Circuit

### 7.8.1 Engine coolant – Level check

#### Preconditions

- Engine is stopped and starting disabled.
- MTU Fluids and Lubricants Specifications (A001063/..) are available.

#### WARNING



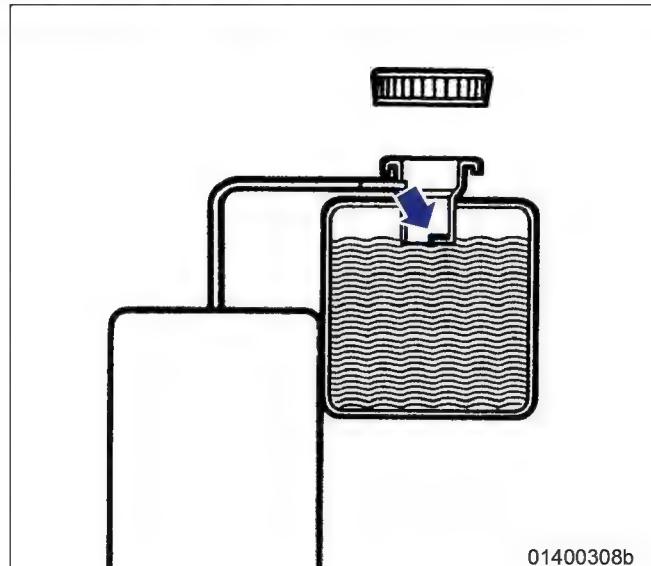
Coolant is hot and under pressure.

#### Risk of injury and scalding!

- Let the engine cool down.
- Wear protective clothing, gloves, and goggles / safety mask.

#### Coolant-level check at filler neck:

1. Turn breather valve on coolant expansion tank counterclockwise to the first stop and allow pressure to escape.
2. Continue to turn breather valve counterclockwise and remove.
3. Check coolant level (coolant must be visible at the lower edge of the cast-in eye or at the marking plate).
4. Top up with treated coolant as necessary (→ Page 94).
5. Check breather valve (visual inspection) and clean if necessary.
6. Place breather valve on filler neck and close.



#### Coolant-level check by means of level sensor:

1. Switch on engine control system and check readings on the display.
2. Top up with treated coolant as necessary (→ Page 94).

## 7.8.2 Engine coolant - Change

### Special tools, Material, Spare parts

| Designation / Use | Part No. | Dty. |
|-------------------|----------|------|
| Coolant           |          |      |

### Engine coolant change

1. Drain engine coolant (→ Page 92).
2. Fill with engine coolant (→ Page 94).

## 7.8.3 Engine coolant – Draining

### Preconditions

Engine is stopped and starting disabled.

### Special tools, Material, Spare parts

| Designation/ Use | Part No.                | Qty. |
|------------------|-------------------------|------|
| Engine coolant   |                         |      |
| Sealing ring     | (→ Spare Parts Catalog) |      |

#### WARNING



Coolant is hot and under pressure.

#### Risk of injury and scalding!

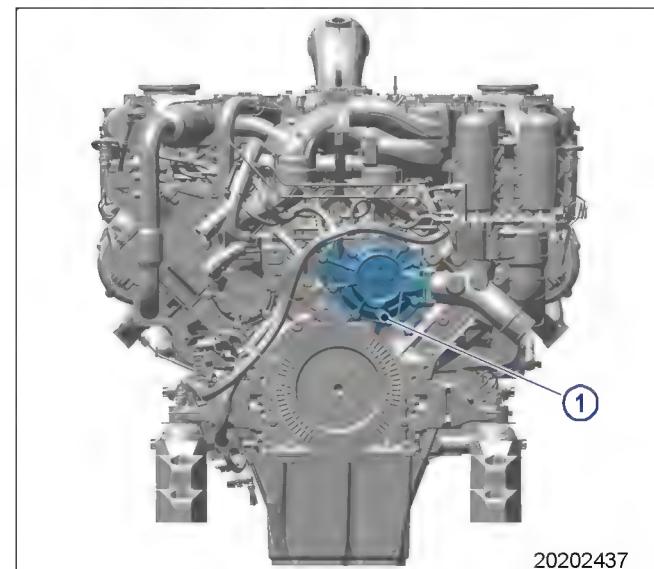
- Let the engine cool down.
- Wear protective clothing, gloves, and goggles / safety mask.

### Preparatory steps

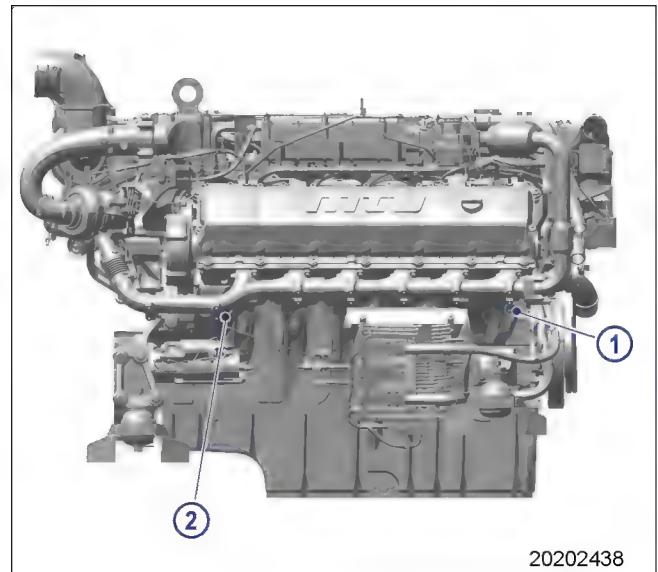
1. Provide an appropriate container to drain the coolant into.
2. Switch off preheater, if installed.

### Engine coolant – Draining

1. Turn breather valve of filler neck on coolant expansion tank counterclockwise to first stop and allow pressure to escape.
2. Continue to turn breather valve counterclockwise and remove.
3. Draw off precipitated corrosion inhibitor oil from the expansion tank through filler neck.
4. Open drain screw and drain off coolant at engine coolant pump (1).

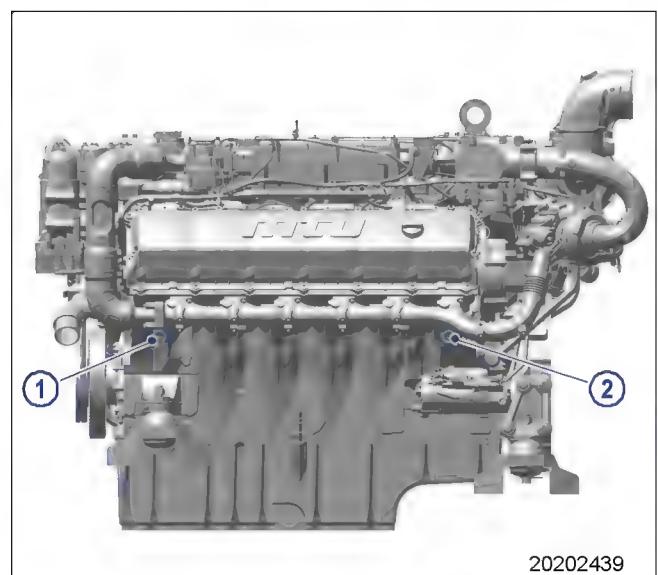


5. Open drain screws and drain coolant at crankcase, right side (1,2).



20202438

6. Open drain screws and drain coolant at crankcase, left side (1,2).
7. Install drain screw with new sealing ring.
8. Place breather valve on filler neck and close.



20202439

## 7.8.4 Engine coolant – Filling

### Preconditions

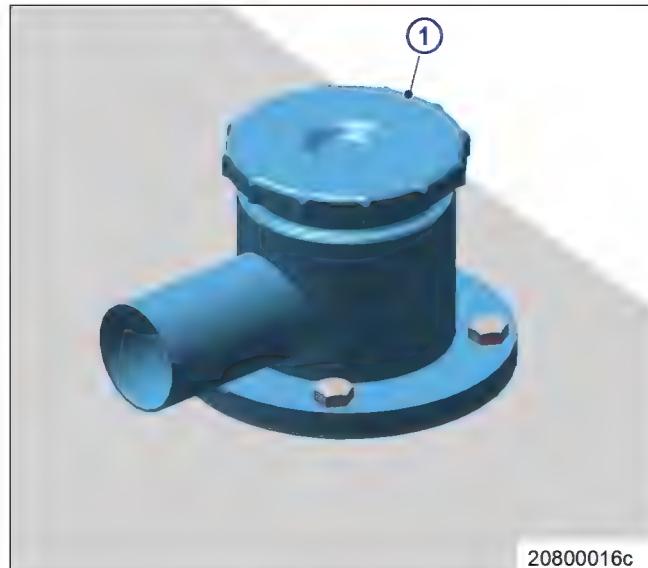
- Engine is stopped and starting disabled.
- MTU Fluids and Lubricants Specifications (A001063/..) are available.

### Special tools, Material, Spare parts

| Designation / Use   | Part No.   | Qty. |
|---|--|------|
| Coolant   |  |      |
| <b>WARNING</b>  |  |      |
|    | <p>Coolant is hot and under pressure.<br/><b>Risk of injury and scalding!</b></p> <ul style="list-style-type: none"><li>Let the engine cool down.</li><li>Wear protective clothing, gloves, and goggles / safety mask.</li></ul> |      |
| <b>WARNING</b>  |  |      |
|    | <p>High level of engine noise when the engine is running.<br/><b>Risk of damage to hearing!</b></p> <ul style="list-style-type: none"><li>Wear ear protectors.</li></ul>   |      |
| <b>NOTICE</b>   |  |      |
|  | <p>Cold coolant in hot engine can cause thermal stress.<br/><b>Possible formation of cracks in the engine!</b></p> <ul style="list-style-type: none"><li>Fill / top up coolant only into cold engine.</li></ul>                  |      |

### Preparatory steps

- Turn breather valve (1) of coolant expansion tank counterclockwise until the first stop and allow pressure to escape.
- Continue to turn valve cover (1) counterclockwise and remove.



### Coolant – Filling

- Fill coolant through filler neck on expansion tank or through filling line until coolant level reaches lower edge of cast-in eye or marking plate.
- Check proper condition of breather valve (1), clean sealing faces if required.
- Fit breather valve (1) and close it.

## **Final steps**

1. Start the engine and operate it at idle speed for some minutes.
2. Check coolant level (→ Page 90), top up with coolant if required.

## 7.8.5 Engine coolant pump – Relief bore check

### DANGER



Rotating and moving engine parts.

#### **Risk of crushing, danger of parts of the body being caught or pulled in!**

- Only run the engine at low power. Keep away from the engine's danger zone.

### WARNING



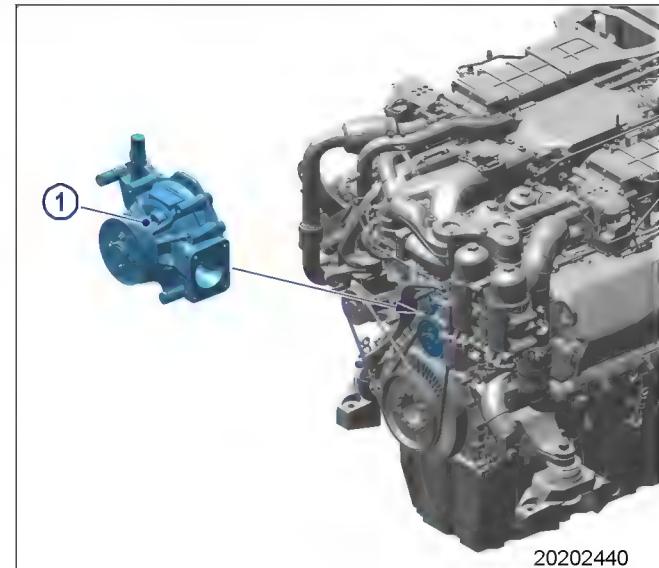
High level of engine noise when the engine is running.

#### **Risk of damage to hearing!**

- Wear ear protectors.

### Engine coolant pump – Relief bore check

1. Check relief bore (1) for coolant discharge.
  - Permissible coolant discharge quantity:  
Up to 0.1 ml per hour respectively  
100 ml per 1,000 operating hours.
2. Stop engine (→ Page 29) and disable engine start.
3. If discharge exceeds the specified limits, contact Service.



20202440

## 7.9 Low-Temperature Circuit

### 7.9.1 Charge-air coolant level - Check

#### Preconditions

- Engine is stopped and starting disabled.
- MTU Fluids and Lubricants Specifications (A001063/..) are available.

WARNING



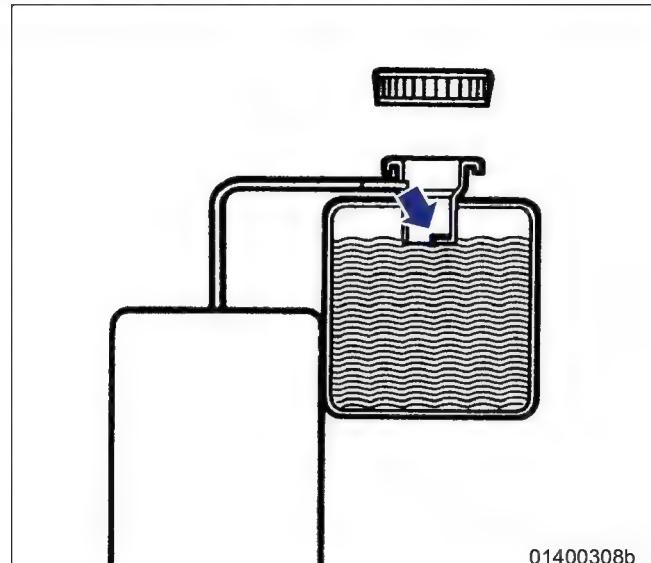
Coolant is hot and under pressure.

**Risk of injury and scalding!**

- Let the engine cool down.
- Wear protective clothing, gloves, and goggles / safety mask.

#### Checking charge-air coolant level at filler neck

1. Turn breather valve on coolant expansion tank counterclockwise to the first stop and allow pressure to escape.
2. Continue to turn breather valve counterclockwise and remove.
3. Check coolant level (coolant must be visible at marker plate).
4. Top up coolant if necessary (→ Page 100).
5. Check satisfactory condition of breather valve, clean sealing faces if required.
6. Fit breather valve and close it.



#### Checking charge-air coolant level by means of level sensor

1. Switch on engine control system and check display (coolant level is automatically monitored by engine control system).
2. Top up coolant if necessary (→ Page 100).

## 7.9.2 Charge-air coolant – Change

### Special tools, Material, Spare parts

| Designation / Use | Part No. | Oty. |
|-------------------|----------|------|
| Coolant           |          |      |

### Charge-air coolant – Change

1. Drain charge-air coolant (→ Page 99).
2. Fill with charge-air coolant (→ Page 100).

### 7.9.3 Charge-air coolant – Draining

#### Preconditions

- Engine is stopped and starting disabled.

#### Special tools, Material, Spare parts

| Designation / Use | Part No. | Qty.                    |
|-------------------|----------|-------------------------|
| Sealing ring      |          | (→ Spare Parts Catalog) |
| Sealing ring      |          | (→ Spare Parts Catalog) |

#### WARNING



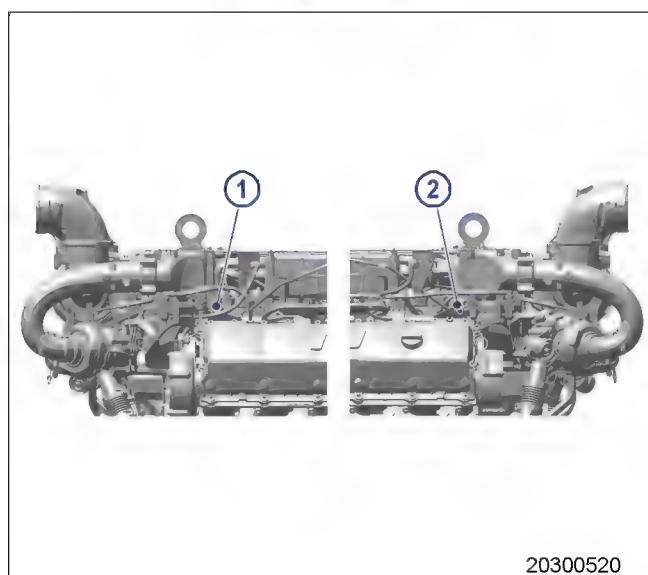
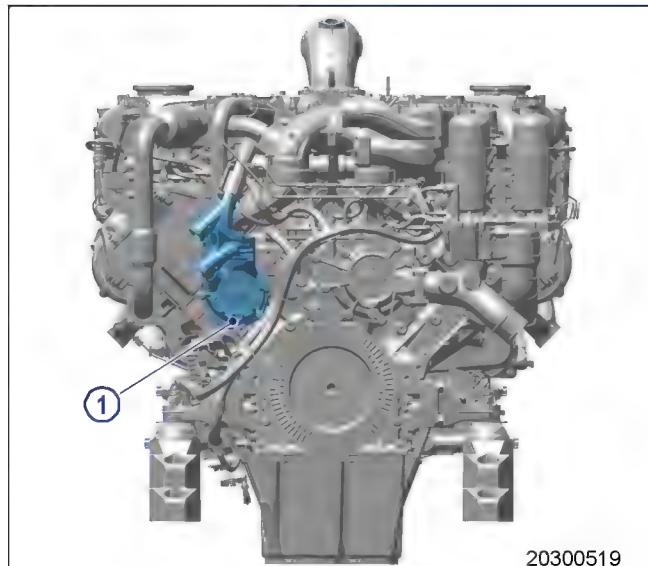
Coolant is hot and under pressure.

#### Risk of injury and scalding!

- Let the engine cool down.
- Wear protective clothing, gloves, and goggles / safety mask.

#### Charge-air coolant – Draining

1. Provide an appropriate container to drain the coolant into.
2. Turn breather valve on coolant expansion tank counterclockwise to the first stop and allow pressure to escape.
3. Continue to turn breather valve counterclockwise and remove.
4. Draw off precipitated corrosion inhibitor oil from the expansion tank through filler neck.
5. Open drain screw and drain off coolant at the charge-air coolant pump (1).
6. Open drain plugs and drain coolant on the intercooler, right (1) and left side (2).
7. Screw in drain plugs with new sealing rings.
8. Place breather valve on filler neck and close.



## 7.9.4 Charge-air coolant – Filling

### Preconditions

- Engine is stopped and starting disabled.
- MTU Fluids and Lubricants Specifications (A001063/..) are available.

### Special tools, Material, Spare parts

| Designation / Use  | Part No.                | Qty. |
|--------------------|-------------------------|------|
| Charge-air coolant |                         |      |
| Sealing ring       | (→ Spare Parts Catalog) |      |

#### WARNING



Coolant is hot and under pressure.

#### Risk of injury and scalding!

- Let the engine cool down.
- Wear protective clothing, gloves, and goggles / safety mask.

#### WARNING



High level of engine noise when the engine is running.

#### Risk of damage to hearing!

- Wear ear protectors.

#### NOTICE



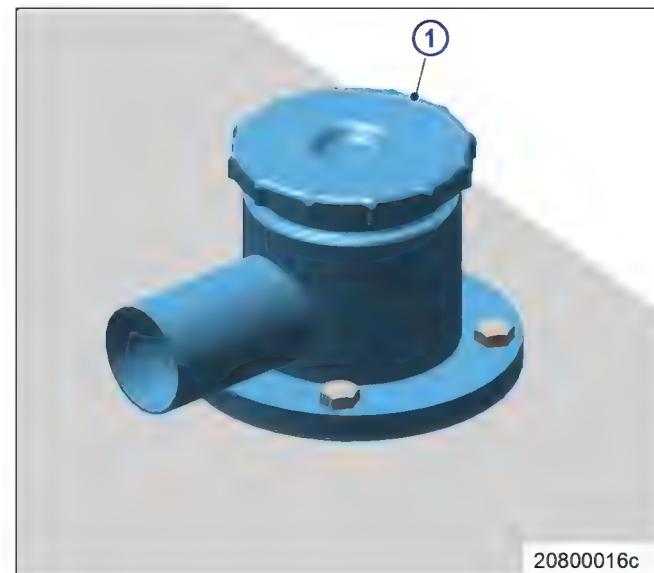
Cold coolant in hot engine can cause thermal stress.

#### Possible formation of cracks in the engine!

- Fill / top up coolant only into cold engine.

### Preparatory steps

1. Turn breather valve (1) on coolant expansion tank counterclockwise to the first stop and allow pressure to escape.
2. Continue to turn breather valve (1) counterclockwise and remove.
3. Remove plug screw from filling point on coolant line to intercooler.



### Charge-air coolant – Filling

1. Fill treated coolant through filling line or through filler neck of coolant expansion tank until coolant level reaches marker plate.
2. Install plug screws of filling points with new sealing rings.
3. Check proper condition of breather valve (1), clean sealing faces if required.
4. Fit breather valve (1) and close it.

## **Final steps**

1. Start the engine and operate it at idle speed for some minutes.
2. Check coolant level (→ Page 97).

## 7.9.5 Charge-air coolant pump – Relief bore check

### DANGER



Rotating and moving engine parts.

#### **Risk of crushing, danger of parts of the body being caught or pulled in!**

- Only run the engine at low power. Keep away from the engine's danger zone.

### WARNING



High level of engine noise when the engine is running.

#### **Risk of damage to hearing!**

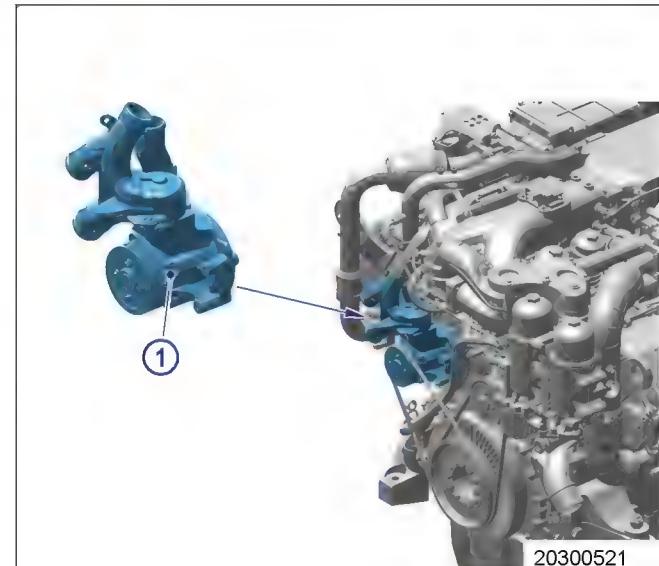
- Wear ear protectors.

### Charge-air coolant pump – Relief bore check

1. Check relief bore (1) for coolant discharge.
  - Permissible coolant discharge: Up to 0.1 ml per hour respectively 100 ml per 1,000 operating hours.

Result: If discharge exceeds the specified limits, contact Service.

2. If relief bore (1) is clogged:
  - Stop engine (→ Page 29) and disable engine start.
  - Clean relief bore (1) with wire.



## 7.10 Belt Drive

### 7.10.1 Coolant pump - Drive belt replacement

#### Preconditions

Engine is stopped and starting disabled.

#### Special tools, Material, Spare parts

| Designation / Use | Part No.                | Dty. |
|-------------------|-------------------------|------|
| Assembly jig      | F6794712                | 1    |
| Poly-vee belt     | (→ Spare Parts Catalog) |      |

#### DANGER



Rotating and moving engine parts.

#### Risk of crushing, danger of parts of the body being caught or pulled in!

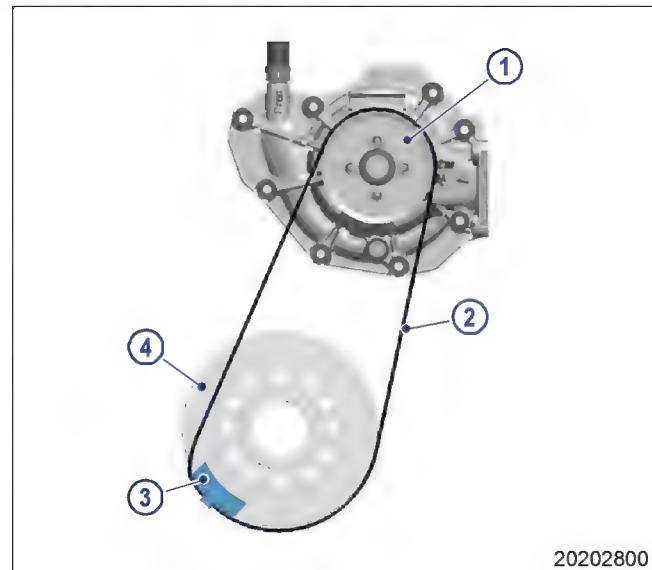
- Before cranking the engine, make sure that there are no persons in the engine's danger zone.
- After finishing work on the engine, make sure that all safety devices are put back in place and all tools removed from the engine.

#### Preparatory step

1. Install barring gear (→ Page 32).
2. Cut poly-vee belt (2) on charge-air coolant pump and engine coolant pump with a suitable cutting tool.

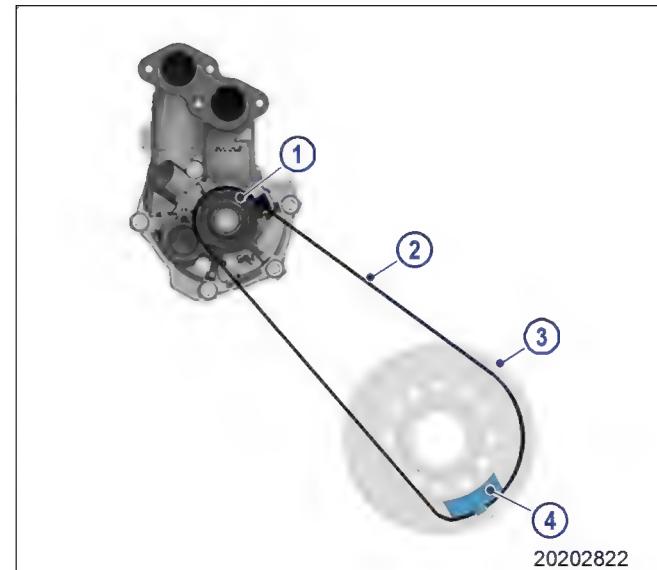
#### Replacing engine coolant pump drive belt (HT circuit)

1. Fit new poly-vee belt (2) on back four grooves of belt pulley (1) to crankshaft.
2. Fit poly-vee belt (2) on back four grooves of belt pulley (4) to crankshaft and preload with assembly jig (3).
3. Bar engine with barring gear until poly-vee belt (2) lies completely on belt pulley (4).
4. Remove assembly jig (3).



## Replacing charge-air coolant pump drive belt (LT circuit)

1. Fit new poly-vee belt (2) on front three grooves of belt pulley (1) to crankshaft.
2. Fit poly-vee belt (2) on front three grooves of belt pulley (3) to crankshaft and preload with assembly jig (4).
3. Bar engine with barring gear until poly-vee belt (2) lies completely on belt pulley (3).
4. Remove assembly jig (4).



### Final step

► Install barring gear (→ Page 32).

## 7.11 Battery-Charging Generator

### 7.11.1 Battery-charging generator - Belt tensioner and diverter pulley replacement

#### Preconditions

Engine is stopped and starting disabled.

#### Special tools, Material, Spare parts

| Designation / Use        | Part No.                | Dty. |
|--------------------------|-------------------------|------|
| Torque wrench, 20-100 Nm | F30026582               | 1    |
| Ratchet adapter          | F30027340               | 1    |
| Engine oil               |                         |      |
| Belt tensioner           | (→ Spare Parts Catalog) |      |
| Diverter pulley          | (→ Spare Parts Catalog) |      |

**WARNING**



Spring/circlip/tensioning roller preload.

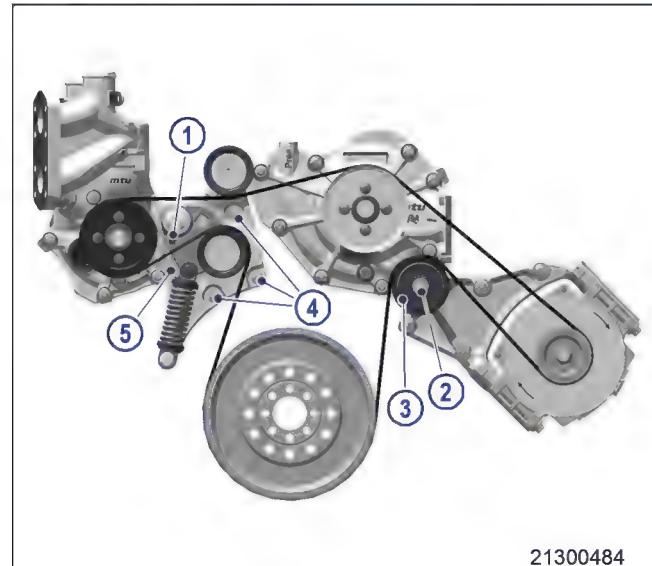
**Risk of injury!**

- Only use specified tool and equipment.

#### Preparatory step

► Remove battery-charging generator drive belt (→ Page 107).

#### Replacing belt tensioner and diverter pulley



21300484

#### Replacing belt tensioner

1. Remove screws (4).
2. Remove belt tensioner (5).

Note: Leave pin (1) in new belt tensioner.

3. Install new belt tensioner (5).
4. Coat screws (4) with engine oil.
5. Tighten screws (4).

## Replacing diverter pulley

1. Remove cap on diverter pulley (3).
2. Remove screw (2).
3. Remove diverter pulley (3).
4. Coat thread of screw (2) with engine oil.
5. Install new diverter pulley (3) with screw (2).
6. Tighten screw (2) to specified torque using a torque wrench.

| Name  | Size | Type              | Lubricant    | Value/Standard |
|-------|------|-------------------|--------------|----------------|
| Screw |      | Tightening torque | (Engine oil) | 60 Nm ±10 Nm   |

7. Install cap to diverter pulley (3).

## Final steps

Note: Remove pin (1) before releasing the belt tensioner.  
► Install battery-charging generator drive belt (→ Page 107).

## 7.11.2 Battery-charging generator – Drive belt removal and installation

### Preconditions

- Engine is stopped and starting disabled.

#### WARNING



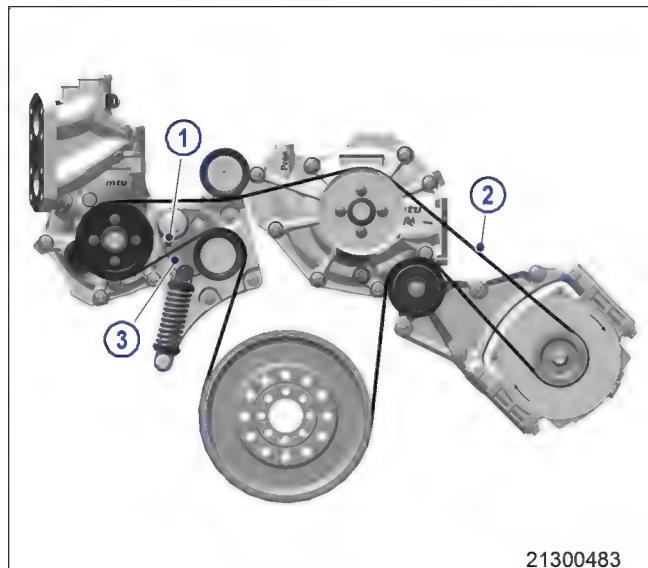
Spring/circlip/tensioning roller preload.

#### Risk of injury!

- Only use specified tool and equipment.

### Removing battery-charging generator drive belt

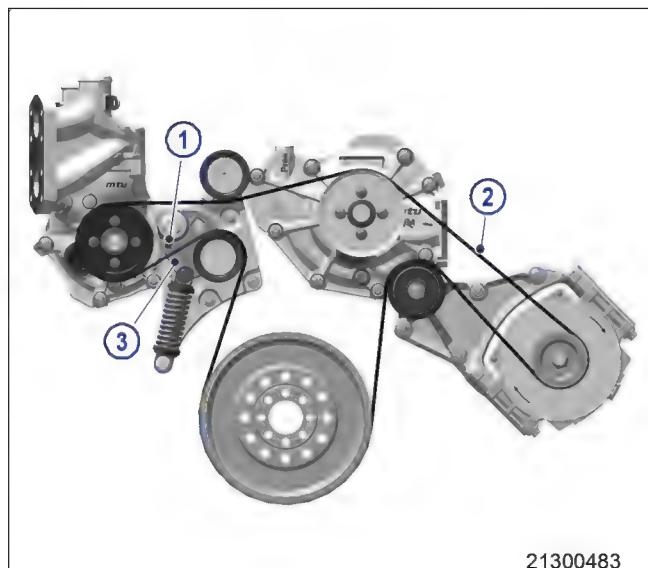
- Place toggle on belt tensioner (3).
- Tighten belt tensioner (3) with toggle.
- Secure belt tensioner (3) with pin (1).
- Remove drive belt (2).
- Tighten belt tensioner (3) with toggle until pin (1) can be removed.
- Remove pin (1).
- Release belt tensioner (3) with toggle and remove toggle.



21300483

### Installing battery-charging generator drive belt

- Place toggle on belt tensioner (3).
- Tighten belt tensioner (3) with toggle.
- Secure belt tensioner (3) with pin (1).
- Fit drive belt (2).
- Tighten belt tensioner (3) with toggle until pin (1) can be removed.
- Remove pin (1).
- Release belt tensioner (3) with toggle and remove toggle.



21300483

## 7.12 Drive Systems, Driving End and Free End (Coupling)

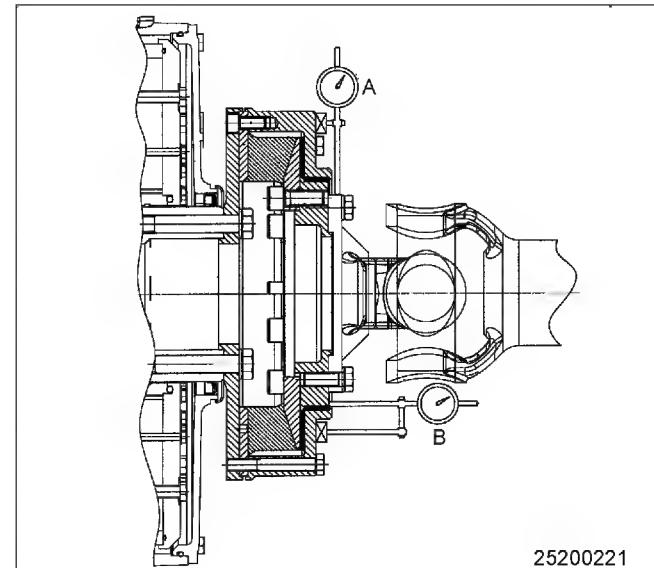
### 7.12.1 Coupling - Checking (radial/axial) play

#### Preconditions

- Engine is stopped and starting disabled.
- Guard is removed.

#### Checking radial play "A"

1. Mount dial gage on engine-side coupling flange.
2. Set dial-gage anvil onto outer coupling part.
3. Push coupling inner part over the drive shaft connecting flange upwards towards the dial gage. Use a suitable tool to move the connecting flange (mounting lever).
4. Set dial gage to zero.
5. Press connecting flange in opposite direction.
6. Take reading on dial gage.
7. Carry out this measuring procedure two times with the measuring points arranged 90 degrees from each other.
8. Bearing bushing wear is equal to the half of the measured value. If the measured value exceeds 0.3 mm (0.15 mm wear), contact Service.



#### Checking axial play "B"

1. Mount dial gage on engine-side coupling flange.
2. Set dial-gage anvil onto coupling front face.
3. Push inner coupling part gently over the drive shaft connecting flange towards the dial gage.
4. Set dial gage to zero.
5. Press inner coupling part in opposite direction.
6. Take reading on dial gage.
7. Repeat measurement several times.
8. If measurement reveals play in coupling, contact Service.

## 7.13 Wiring (General) for Engine/Gearbox/Unit

### 7.13.1 Engine wiring - Check

#### Preconditions

Engine is stopped and starting disabled.

#### Special tools, Material, Spare parts

| Designation / Use | Part No.  | Dty. |
|-------------------|-----------|------|
| Isopropyl alcohol | X00058037 | 1    |

#### Engine wiring - Check

1. Check securing screws of cable clamps on engine and tighten loose threaded connections.
2. Ensure that cables are fixed in their clamps and cannot swing freely.
3. Verify that all cable clips are closed and in proper condition.
4. Replace cable clips if defective.
5. Check that cable clamps are firm, tighten loose cable clamps.
6. Replace faulty cable clamps.
7. Visually inspect the following electrical line components for damage:
  - Connector housing
  - Contacts
  - Sockets
  - Cables and terminals
  - Plug-in contacts

Result: Contact Service if cable conductors are damaged.

Note: Close male connectors that are not plugged in with the protective cap supplied.

8. Clean dirty connector housings, sockets and contacts using isopropyl alcohol.
9. Ensure that all sensor connectors are securely engaged.

## 7.14 Accessories for (Electronic) Engine Governor / Control System

### 7.14.1 Injector functions

#### **Preconditions**

- Engine is stopped and starting disabled.

Note: Failure to reset drift compensation parameters (CDC) will void the emissions certification for the engine.

#### **Resetting drift correction parameters (CDC) with DiaSys®**

1. (→ Dialog system DiaSys® E531920/..).
2. If no DiaSys® is available, contact Service.

#### **Entering injector coding (IIG)**

1. (→ Dialog system DiaSys® E531920/..).
2. If no DiaSys® is available, contact Service.

## 7.14.2 Engine governor and connectors – Cleaning

### Preconditions

Engine is stopped and starting disabled.

### Special tools, Material, Spare parts

| Designation / Use | Part No.  | Qty. |
|-------------------|-----------|------|
| Isopropyl alcohol | X00058037 | 1    |

Note: Always use test connectors to enter the connectors. Never use test leads for this purpose. Otherwise the contacts could be bent.

### Engine governor and connectors – Cleaning

1. Remove coarse dirt from housing surface using a cloth moistened with isopropyl alcohol.
2. Remove dirt from the connector and cable surfaces with isopropyl alcohol.
3. Check legibility of cable labels. Clean or replace illegible labels.

### Cleaning severely contaminated connectors on the engine governor

Note: Seal unused connectors with the supplied protective cap.

1. Release the latch and pull off connectors.
2. Clean connector housings, connector socket housings and all contacts with isopropyl alcohol.
3. When connectors, sockets and all contacts are dry: Fit connectors and lock them.

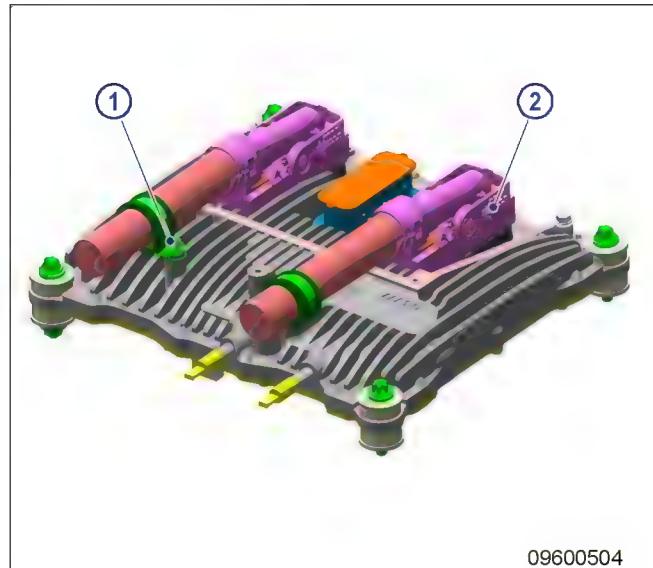
### 7.14.3 Engine Control Unit - Plug connection check

#### Preconditions

Engine is stopped and starting disabled.

#### Checking Engine Control Unit plug connections

1. Check firm seating of all connectors on the Engine Control Unit. Make sure that the clips (2) are engaged.
2. Check firm seating of all screws (1) on Engine Control Unit cable clamps. Make sure that cable clamps are not defective.



## 7.14.4 NOx sensor - Replacement

### Preconditions

- Engine is stopped and starting disabled.

### Special tools, Material, Spare parts

| Designation / Use                 | Part No.                | Qty. |
|-----------------------------------|-------------------------|------|
| Torque wrench, 10-60 Nm           | F30510423               | 1    |
| Ratchet                           | F30027340               | 1    |
| Assembly compound (Molykote P 37) | 50564                   | 1    |
| NOx sensor                        | (→ Spare Parts Catalog) | 1    |

#### WARNING



Component is hot.

#### Risk of burning!

- Wear protective gloves.

#### NOTICE



High voltage.

#### Risk of damage to components!

- Switch off ignition before replacing components.

#### NOTICE



Ceramic cell breakage due to shock or impact.

#### Risk of damage to components!

- Avoid shocks and impacts.
- Exercise extreme care when handling sensors.

### Removing NOx sensor

1. Observe the following general information:
  - Layout and position of sensor  
(→ Page 17).
2. Unplug and remove male connector (1) on control unit.
3. Remove sensor (2).
4. Remove control unit.



09600880

Note: Always replace NOx sensor together with control unit.

### Installing NOx sensor

Note:

1. Install control unit.

Note: When the sensor was subjected to shock or impact load, it is deemed to be defective and may not be used.

2. Remove protective cap on thread only just before installation.

Note: Do not wipe off the thread lubricant applied by the manufacturer.

3. Coat sensor thread with specified assembly compound as required.
4. Screw in sensor by hand.



5. Tighten nut (2) to specified torque using a torque wrench.

| Name | Size      | Type              | Lubricant                           | Value/Standard |
|------|-----------|-------------------|-------------------------------------|----------------|
| Nut  | M20 x 1.5 | Tightening torque | (Assembly compound (Molykote P 37)) | 50 Nm ±10 Nm   |

6. Fit male connector (1) and latch it.

## 7.14.5 Lambda sensor - Replacement

### Preconditions

Engine is stopped and starting disabled.

### Special tools, Material, Spare parts

| Designation / Use                 | Part No.                | Qty. |
|-----------------------------------|-------------------------|------|
| Torque wrench, 10-60 Nm           | F30510423               | 1    |
| Ratchet                           | F30027340               | 1    |
| Assembly compound (Molykote P 37) | 50564                   | 1    |
| Lambda sensor                     | (→ Spare Parts Catalog) | 1    |

#### WARNING



Component is hot.

#### Risk of burning!

- Wear protective gloves.

#### NOTICE



Ceramic cell breakage due to shock or impact.

#### Risk of damage to components!

- Avoid shocks and impacts.
- Exercise extreme care when handling sensors.

#### NOTICE



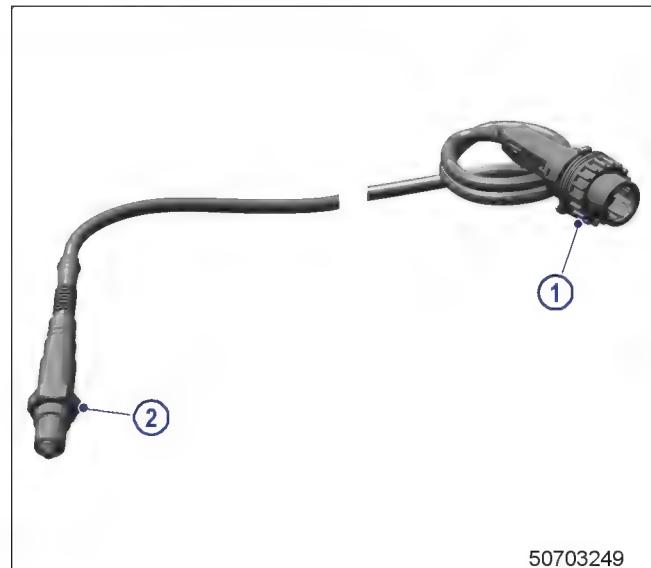
High voltage.

#### Risk of damage to components!

- Switch off ignition before replacing components.

### Removing Lambda sensor

1. Observe the following general information:
  - Layout and position of sensor  
(→ Page 17).
2. Unplug and remove male connector (1).
3. Remove sensor (2).



50703249

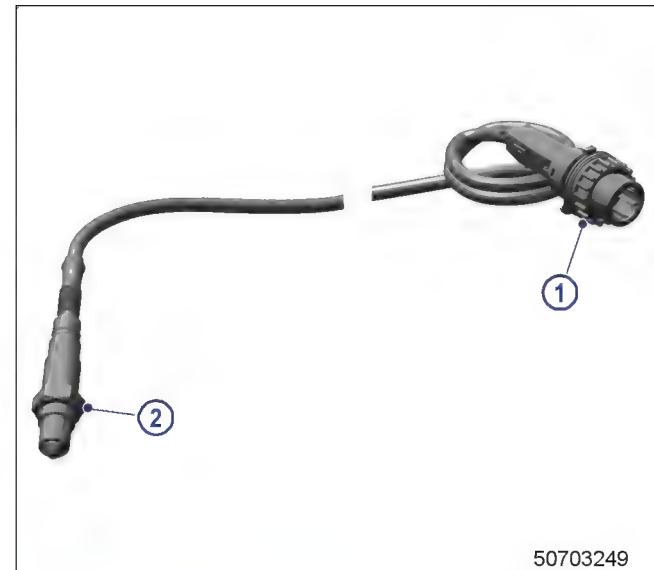
## Installing Lambda sensor

Note: When the sensor was subjected to shock or impact load, it is deemed to be defective and may not be used.

1. Remove protective cap on thread only just before installation.

Note: Do not wipe off the thread lubricant applied by the manufacturer.

2. Coat sensor thread with specified assembly compound as required.
3. Screw in sensor by hand.



4. Tighten nut (2) to specified torque using a torque wrench.

| Name | Size      | Type              | Lubricant                           | Value/Standard |
|------|-----------|-------------------|-------------------------------------|----------------|
| Nut  | M18 x 1.5 | Tightening torque | (Assembly compound (Molykote P 37)) | 40 Nm to 60 Nm |

5. Fit male connector (1) and latch it.

# 8 Appendix A

## 8.1 Abbreviations

| Abbreviation | Meaning   | Explanation  |
|--------------|---|--|
| A/D          | Analog/Digital                                      | Converter: Converts sensor voltages into numerical values  |
| ADEC         | Advanced Diesel Engine Controller                   | Engine management system   |
| AFRS         | Air Filter Restriction Sensor                       |  |
| ANSI         | American National Standards Institute               | Association of American standardization organizations  |
| ATL          | Abgasturbolader                                     | Exhaust turbocharger   |
| ATS          | Air Temperature Sensor                              |  |
| BR           | Baureihe  | Series   |
| BV           | Betriebsstoffvorschrift                             | Fluids and Lubricants Specifications, MTU Publication No. A01063/..  |
| CAN          | Controller Area Network                             | Data bus system, bus standard  |
| CDC          | Calibration Drift Compensation                      | Setting of drift compensation in engine governor with DiaSys   |
| CEL          | Check Engine Light                                  | 1st function: Warning lamp (rectify fault as soon as possible)<br>2nd function: Read out fault codes                   |
| CKT          | Circuit   |  |
| CLS          | Coolant level sensor                                | Monitors coolant level   |
| CPS          | Coolant pressure sensor                             | Monitors coolant pressure  |
| CTS          | Coolant temperature sensor                          | Monitors coolant temperature   |
| DDEC         | Detroit Diesel Electronic Controls                  | Engine control system made by Detroit Diesel   |
| DDL          | Diagnostic Data Link                                | Diagnostic lines   |
| DDR          | Diagnostic Data Reader                              | Diagnostic unit  |
| DIN          | Deutsches Institut für Normung e. V.                | German National Standards Institute. At the same time identifier of German standards (DIN = "Deutsche Industrie-Norm") |
| DL           | Default Lost  | Alarm: Default CAN bus failure   |
| DOC          | Diesel Oxidation Catalyst                           | Oxidation catalyst upstream of the diesel particulate filter   |
| DPF          | Diesel particulate filter                           |  |
| DT           | Diagnostic Tool                                     | Diagnostic unit  |
| ECM          | Electronic Control Module                           | Electronic control unit of the DDEC system   |
| ECU          | Engine Control Unit                                 | Engine governor  |
| EDM          | Engine Data Module                                  | Memory module for engine data  |
| EEPROM       | Electrically Erasable Programmable Read Only Memory |  |
| EFPA         | Electronic Foot Pedal Assembly                      |  |
| EGR          | Exhaust Gas Recirculation                           |  |
| EMU          | Engine Monitoring Unit                              |  |

| Abbreviation | Meaning  | Explanation   |
|--------------|--|---|
| ETK          | Ersatzteilkatalog                              | Spare Parts Catalog   |
| EUI          | Electronic Unit Injector                       |   |
| FPS          | Fuel Pressure Sensor                           | Monitors fuel pressure  |
| FRS          | Fuel - Differential Pressure Sensor            |   |
| FTS          | Fuel Temperature Sensor                        | Monitors fuel temperature   |
| FWCP         | Fire Water Control Panel                       | Control cabinet   |
| GND          | Ground   |   |
| HD           | Hochdruck                                      | High pressure   |
| HI           | High   | Alarm: Measured value exceeds 1st maximum limit                                 |
| HIHI         | High High                                      | Alarm: Measured value exceeds 2nd maximum limit value                           |
| HT           | High Temperature                               |   |
| IDM          | Interface Data Module                          | Memory module for interface data  |
| INJ          | Injector                                       |   |
| ISO          | International Organization for Standardization | International umbrella organization for all national standardization institutes |
| KGS          | Kraftgegenseite                                | Engine free end in accordance with DIN ISO 1204                                 |
| KS           | Kraftseite                                     | Engine driving end in accordance with DIN ISO 1204                              |
| LED          | Light Emitting Diode                           |   |
| LO           | Low  | Alarm: Measured value lower than 1st minimum limit value                        |
| LOLO         | Low Low  | Alarm: Measured value lower than 2nd minimum limit value                        |
| LSG          | Limiting Speed Governor                        |   |
| N/A          | Not Applicable                                 |   |
| LP           | Low Pressure                                   |   |
| NT           | Niedertemperatur-                              | Low temperature   |
| OEM          | Original Equipment Manufacturer                |   |
| OI           | Optimized Idle                                 |   |
| OLS          | Oil Level Sensor                               | Monitors oil level  |
| OPS          | Oil pressure sensor                            | Monitors oil pressure   |
| OTS          | Oil Temperature Sensor                         | Monitors oil temperature  |
| OT           | Oberer Totpunkt                                | Top dead center   |
| PAN          | Panel  | Control panel   |
| PIM          | Peripheral Interface Module                    |   |
| PWM          | Pulse-Width Modulation                         |   |
| P-xyz        | Pressure-xyz                                   | Pressure measuring point, xyz specifies the measuring point designation         |
| RL           | Redundancy Lost                                | Alarm: Redundant CAN bus failure  |
| SAE          | Society of Automotive Engineers                | U.S. standardization organization   |
| SD           | Sensor Defect                                  | Alarm: Sensor failure   |

| Abbreviation | Meaning                      | Explanation  |
|--------------|------------------------------|--|
| SEL          | Check Engine Light           | 1st function: Warning lamp (stop engine and rectify fault)<br>2nd function: Read out fault codes |
| SID          | System Identifier            |  |
| SRS          | Synchronous Reference Sensor | TDC cylinder 1   |
| SS           | Safety System                | Safety system alarm  |
| TBS          | Turbocharger Boost Sensor    | Monitors charge-air pressure   |
| TCI          | Turbo Compressor Inlet       |  |
| TCO          | Turbo Compressor Outlet      |  |
| TD           | Transmitter Deviation        | Alarm: Deviation in transmitter values   |
| TPS          | Throttle Position Sensor     |  |
| TRS          | Timing Reference Sensor      |  |
| T-xyz        | Temperature-xyz              | Temperature measuring point, xyz specifies the measuring point designation                       |
| UT           | Unterer Totpunkt             | Bottom dead center   |
| VNT          | Variable Nozzle Turbine      |  |
| VSG          | Variable-Speed Governor      |  |
| VSS          | Vehicle Speed Sensor         |  |
| WZK          | Werkzeugkatalog              | Tool Catalog   |

## 8.2 MTU contact persons/service partners

Our worldwide sales network with its subsidiaries, sales offices, representatives and customer service centers ensures fast and direct support on site and the high availability of our products.

### **Local support**

Experienced and qualified specialists place their knowledge and expertise at your disposal.

For locally available support, go to the MTU Internet site: <http://www.mtu-online.com>

### **24h hotline**

With our 24h hotline and the outstanding flexibility of our service staff, we are always ready to assist you – either during operation, for preventive maintenance, corrective work in case of malfunction or changed operating conditions, or for spare parts supply.

Your contact person in our Customer Assistance Center:

E-mail: [info@mtu-online.com](mailto:info@mtu-online.com)

Tel.: +49 7541 9077777

Fax: +49 7541 9077778

Asia/Pacific: +65 6100 2688

North and Latin America: +1 248 560 8000

### **Spare parts service**

Fast, simple and correct identification of spare parts for your drive system or vehicle fleet. The right spare part at the right time at the right place.

With this aim in mind, we can call on a globally networked spares logistics system, a central warehouse at headquarters and on-site stores at our subsidiary companies, agencies and service workshops.

Your contact at Headquarters:

E-mail: [spare.parts@mtu-online.com](mailto:spare.parts@mtu-online.com)

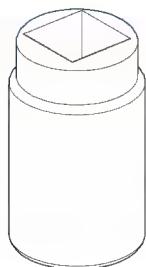
Tel.: +49 7541 908555

Fax: +49 7541 908121

# 9 Appendix B

## 9.1 Special Tools

### Adapter

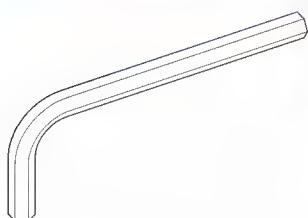


Part No.: F30011619

Qty.: 1  
Used in:

4.8 Engine – Barring manually (→ Page 32)

### Allen key, 5 mm

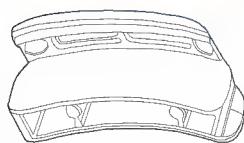


Part No.: F30002815

Qty.: 1  
Used in:

7.1.1 Valve clearance – Check and adjustment  
(→ Page 76)

### Assembly jig

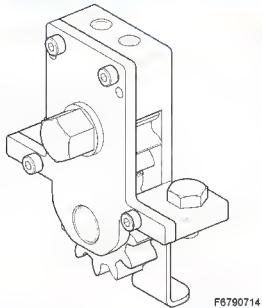


Part No.: F6794712

Qty.: 1  
Used in:

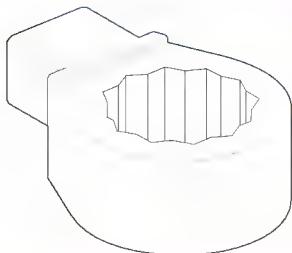
7.10.1 Coolant pump – Drive belt replacement  
(→ Page 103)

### Barring gear



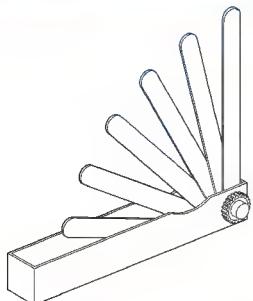
|           |  |
|-----------|--|
| Part No.: | F6790714   |
| Qty.:     | 1  |
| Used in:  | 4.8 Engine – Barring manually (→ Page 32)                |
| Qty.:     | 1  |
| Used in:  | 7.1.1 Valve clearance – Check and adjustment (→ Page 76) |

### Box wrench, 14 mm



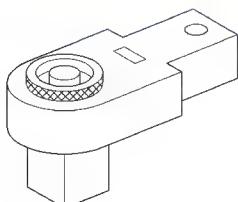
|           |  |
|-----------|--|
| Part No.: | F30028346  |
| Qty.:     | 1  |
| Used in:  | 7.1.1 Valve clearance – Check and adjustment (→ Page 76) |

### Feeler gage



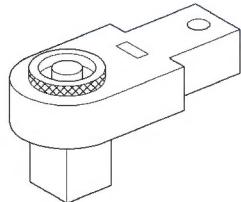
|           |  |
|-----------|--|
| Part No.: | Y20010128  |
| Qty.:     | 1  |
| Used in:  | 7.1.1 Valve clearance – Check and adjustment (→ Page 76) |

### Ratchet



|           |   |
|-----------|---|
| Part No.: | F30027340   |
| Qty.:     | 1   |
| Used in:  | 7.2.1 Fuel system – Venting (→ Page 79)                       |
| Qty.:     | 1   |
| Used in:  | 7.3.1 Fuel filter – Replacement (→ Page 81)                   |
| Qty.:     | 1   |
| Used in:  | 7.3.3 Fuel prefilter – Filter element replacement (→ Page 84) |
| Qty.:     | 1   |
| Used in:  | 7.7.1 Engine oil filter – Replacement (→ Page 89)             |
| Qty.:     | 1   |
| Used in:  | 7.14.4 NOx sensor – Replacement (→ Page 113)                  |
| Qty.:     | 1   |
| Used in:  | 7.14.5 Lambda sensor – Replacement (→ Page 115)               |

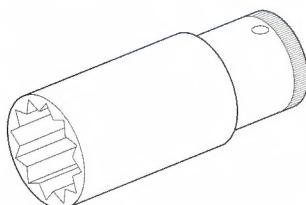
### Ratchet adapter



Part No.: F30027340

|          |   |
|----------|---|
| Qty.:    | 1   |
| Used in: | 4.8 Engine – Barrings manually (→ Page 32)  |
| Qty.:    | 1   |
| Used in: | 7.11.1 Battery-charging generator – Belt tensioner and diverter pulley replacement (→ Page 105) |

### Socket, 32 mm



Part No.: F30006120

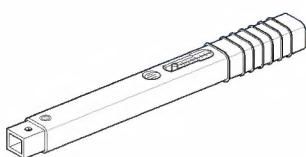
|          |   |
|----------|---|
| Qty.:    | 1   |
| Used in: | 7.3.1 Fuel filter – Replacement (→ Page 81)       |
| Qty.:    | 1   |
| Used in: | 7.7.1 Engine oil filter – Replacement (→ Page 89) |

### Steam jet cleaner

Part No.: -

|          |                                  |
|----------|----------------------------------|
| Qty.:    | 1                                |
| Used in: | 4.7 Plant – Cleaning (→ Page 31) |

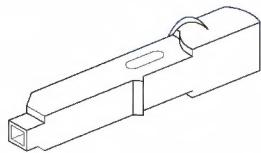
### Torque wrench, 20-100 Nm



Part No.: F30026582

|          |   |
|----------|---|
| Qty.:    | 1   |
| Used in: | 7.1.1 Valve clearance – Check and adjustment (→ Page 76)  |
| Qty.:    | 1   |
| Used in: | 7.11.1 Battery-charging generator – Belt tensioner and diverter pulley replacement (→ Page 105) |

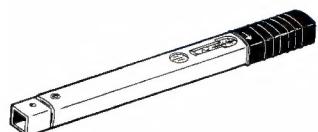
#### Torque wrench, 4-20 Nm



Part No.: F30044239

Qty.: 1  
Used in: 7.2.1 Fuel system - Venting (→ Page 79)

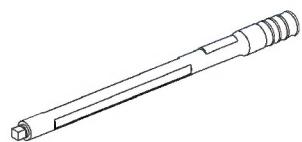
#### Torque wrench, 6-50 Nm



Part No.: F30027336

Qty.: 1  
Used in: 7.3.3 Fuel prefilter - Filter element replacement  
(→ Page 84)

#### Torque wrench, 10-60 Nm



Part No.: F30510423

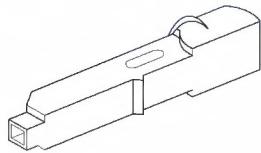
Qty.: 1  
Used in: 7.3.1 Fuel filter - Replacement (→ Page 81)

Qty.: 1  
Used in: 7.7.1 Engine oil filter - Replacement (→ Page 89)

Qty.: 1  
Used in: 7.14.4 NOx sensor - Replacement (→ Page 113)

Qty.: 1  
Used in: 7.14.5 Lambda sensor - Replacement (→ Page 115)

#### Torque wrench, 4-20 Nm



Part No.: F30044239

Qty.: 1  
Used in: 7.3.1 Fuel filter - Replacement (→ Page 81)

## 9.2 Index

### A

- Abbreviations 117
- Actuators
  - Overview 17
- After engine shutdown 30
- Air filter
  - Replacement 85

### B

- Battery-charging generator
  - Belt tensioner
    - Replacement 105
  - Diverter pulley
    - Replacement 105
  - Drive belt
    - Removal and installation 107

### C

- CDC
  - Reset 110
- Charge-air coolant
  - Change 98
  - Draining 99
  - Filling 100
- Charge-air coolant level
  - Check 97
- Charge-air coolant pump
  - Drive belt
    - Replacement 103
  - Relief bore check 102
- Connectors
  - Cleaning 111
- Contact persons 120
- Coolant
  - Change 91, 98
- Coupling
  - Checking radial/axial play 108
- Cylinder
  - Designation 15
- Cylinder head cover
  - Installation 78
  - Removal 78

### D

- Designations
  - Engine sides and cylinders 15
- Drift correction parameters
  - Reset 110
- Drive belt
  - Battery-charging generator
    - Removal and installation 107
  - Charge-air coolant pump
    - Replacement 103
  - Engine coolant pump
    - Replacement 103

### E

- ECU 9
  - Fault messages 37
- Engine
  - Barring manually 32
  - Overview 16
  - Start 27
  - Stop 29
  - Wiring check 109
- Engine Control Unit
  - Plug connection check 112
- Engine coolant
  - Change 91
  - Draining 92
  - Filling 94
  - Level check 90
- Engine coolant pump
  - Drive belt
    - Replacement 103
  - Relief bore check 96
- Engine data
  - 12V 1600 R50 22
- Engine governor
  - Cleaning 111
- Engine oil
  - Change 88
- Engine oil filter
  - Replacement 89
- Engine oil level
  - Check after stopping the engine 87
  - Check prior to engine start 87
- Engine sides
  - Designation 15
- Engine wiring
  - Check 109

### F

- Fault messages
  - ECU 9 37
- Filter
  - Air
    - Replacement 85
  - Fuel
    - Replacement 81
- Fuel filter
  - Replacement 81
- Fuel prefilter
  - Filter element replacement 84
- Fuel prefilter
  - Drain condensate 83
- Fuel system
  - Venting 79

### H

- Hotline 120

|   |  |
|---|--|
| I   | Startup  |
| IIG   | - After a scheduled break in operation 25              |
| - Input 110                                 | - After extended out-of-service periods (>3 months) 26 |
| Injector coding                             | T  |
| - Input 110                                 | Troubleshooting 34                                     |
| Injector functions 110                      |  |
| L   | V  |
| Lambda sensor                               | Valve clearance  |
| - Replacement 115                           | - Adjustment 76  |
| M   | - Check 76   |
| Main engine dimensions 21                   |  |
| Maintenance schedule                        |  |
| - Maintenance task reference table [QL1] 33 |  |
| MTU contact persons 120                     |  |
| N   |  |
| NOx sensor                                  |  |
| - Replacement 113                           |  |
| O   |  |
| Operational checks 28                       |  |
| Overview                                    |  |
| - Actuators 17                              |  |
| - Sensors 17                                |  |
| P   |  |
| Plant                                       |  |
| - Cleaning 31                               |  |
| R   |  |
| Relief bore                                 |  |
| - Engine coolant pump - Check 96            |  |
| S   |  |
| Safety notices, standards 14                |  |
| Safety regulations                          |  |
| - Consumables 12                            |  |
| - Environmental protection 12               |  |
| - Fire prevention 12                        |  |
| - Fluids and lubricants 12                  |  |
| - Important provisions 5                    |  |
| - Maintenance work 9                        |  |
| - Operation 8                               |  |
| - Organizational requirements 6             |  |
| - Personnel requirements 6                  |  |
| - Repair work 9                             |  |
| - Safety notices, standards 14              |  |
| - Startup 8                                 |  |
| Sensors                                     |  |
| - Lambda                                    |  |
| - Replacement 115                           |  |
| - NOx                                       |  |
| - Replacement 113                           |  |
| - Overview 17                               |  |
| Service partners 120                        |  |
| Spare parts service 120                     |  |